M.A. English

Eileen Blackwell

BLACKWELL

ABSTRACT OF THESIS SUBMITTED FOR THE M.A.DEGREE

APRIL, 1949.

Title:- THE LIFE, TIMES AND WORK OF ERASMUS DARWIN

The aim of the thesis is to depict the achievements of Erasmus Darwin as the poet of science. A brief account of his life is given to indicate the background against which he worked, but no attempt is made here to add to information already available. The Economy of Vegetation, The Loves of the Plants and The Temple of Nature are examined as literary expressions of the impact of new scientific tastes and ideas upon the educated mind of the eighteenth century. Since much of Darwin's material grew out of his contacts with men distinguished in various fields, personal relationships are discussed where they throw light upon the work. His extensive reading has been followed up to investigate the sources of different parts of the poems.

The Economy of Vegetation:- considered under different headings corresponding to the various sciences with which it deals. Darwin's interest in meteorology, cosmogony, geology, chemistry, steam-power, electricity. His relationship with Josiah Wedgwood and his debt to the productions of Etruria; his contribution to the study of mythology; his interest in the classics and the arts.

The Loves of the Plants as a reflection of contemporary interest in, and as an exposition in verse of Linnaean botany. - Personal and topical references and points of special interest.

The Temple of Nature as the expression of Darwin's theories of organic life. The origin of life, the nature of generation, reproduction, evolution. The background of contemporary opinion. Some special features of his theories of psychology and aesthetics; his "philosophy of life".

A brief consideration of Darwin's verse-technique. An attempt to evaluate his success and failure as a scientific poet.

It has not been possible to treat of Darwin's theories of medicine, agriculture or education, but these are hardly relevant to his work as a poet. The prose work has been drawn on where it illuminates the poetry.

THE LIFE, TIMES AND WORK OF ERASMUS DARWIN

- by -

Eileen Blackwell

March, 1949

CONTENTS

Prefatory Note

Editions of Darwin's work to which reference is made are, unless otherwise stated in the notes, as follows:

The Loves of the Plants.	3rd edition, 1791.
The Economy of Vegetation.	1st edition, 1791.
Zoonomia. Vol.I. 2nd edition, 1796. Vol.II, 1st edition. 1796.	
Phytologia. 1800.	
The Temple of Nature.	1st edition, 1803.

Abbreviations used in the notes.

L.P.	=	The Loves of the Plants.
E.V.	=	The Economy of Vegetation.
T.N.	=	The Temple of Nature.
Add.Note	=	Additional Note.

INTRODUCTION

To the present generation of readers Erasmus Darwin is a symbol. The Botanic Garden, when its title is remembered at all, is regarded as the latest product of a spent tradition, a travesty of classical convention, born in the darkest hour before the Romantic dawn. It is an almost mythical storehouse of artificial diction, meaningless periphrasis, mechanical device. Its author is the representative of decadence, an offender against those principles of nature and reason which guided his predecessors, a pompous ape, who, knowing nothing of the spirit which informed the work of Pope, has yet preserved a parody of its form and substance. The only virtue of his poetry is that it can be made to lend a subtle grace of humour to discussions of Wordsworth's starting-points.

Thus rejected by critics of the Romantic poets, as he was rejected by the Romantic poets themselves, and disowned by critics of the classical tradition to which he belongs, Darwin has no existence in his own right. He survives only as an example. And no one could deny that his poetic fate is deserved. The verdict has been pronounced by men of unquestioned judgement, and may easily be confirmed by anyone who takes the trouble to glance at The Botanic Garden. Since this is so, it may be wondered why he has survived at all. There have been plenty of bad poets, and even if Darwin was the worst of these, that would seem an insufficient reason for refusing him a kindly oblivion. Few writers have retained a reputation for sheer ineptitude for more than a hundred and fifty years.

The strange truth is that in his day Erasmus Darwin was a famous poet. The last thing that would have been predicted for him by almost any critic writing about the year 1791 was a sudden and permanent eclipse. It was his very popularity that made him an obvious scapegoat for poetic innovators who were reacting against everything for which he stood. The historical significance at present attached to Darwin's work is a thin shadow of a once splendid reputation. Once his verse was eagerly read and extravagantly praised. He was magnificently paid to produce more. The modern reader may well wonder on what this reputation was based and why The Botanic Garden fulfilled a contemporary demand. What was it that delighted the reading public of the 1790's as it has delighted no generation since? What were Darwin's claims to distinction?

In the first place, his verse, whatever its defects may be, shows an easy mastery of the couplet. The couplet is kinder to the mediocre poet than blank-verse, the other popular form of the day; and Darwin had studied the work of earlier writers to such good purpose that he could produce very convincing imitations of Pope's sentence structure and rhythms, with all the tricks of inversion, balance, and variety that were dear to the heart of the eighteenth century. Both he and his readers could take the medium for granted. It was familiar, their ears were accustomed to it; all they asked was a skilful handling of it, and this Darwin could display. Furthermore, the age could show few poets of distinction, and these, for the most part, had neglected the couplet. It could show, however, many verse-writers of moderate talent, whose work was read by a wide public and imitated by many more with modest pretensions to literary accomplishment. The pursuit of literature was, in fact, regarded as a polite accomplishment, incumbent upon men and women of learning, intellectual ability, or taste. The educated world was a small one, and there was a remarkably free and vigorous intercourse between members of it residing in widely separated parts of the country. Every provincial society had its poets and its connoisseurs of poetry, and there were few among their satellites who had not some acquaintance with the work of Milton and Pope and their innumerable imitators. A sufficient knowledge of recent and contemporary verse-writing was a necessary item of social equipment; and this was so because poetry was a social activity and a common possession in a way that is no longer, for various reasons, possible. In these circumstances anyone who could present interesting, striking or new material with a reasonable degree of skill could hope for distinction as an author. The skill Darwin possessed. He had a powerful command of the conventional vocabulary of fashionable verse, the ability to invest his descriptions with colour, light and movement in abundance, and a certain lightness of touch, or whimsical humour. With these qualifications he had also the good fortune, or the good sense, to light upon subject matter with an immediate general appeal. For his first poem he chose botany, another favoured pursuit of the polite world. This, as a literary topic, was new. The Linnaean system then in vogue gave ample scope to his facility in personification, his powers of description, and his gift of humour. It did not demand what he could not give, poetic feeling and imagination. Consequently, the poem was a great success, and his second venture was accordingly more ambitious. This time, although the title of the work was <u>The Economy of Vegetation</u>, he set out to give his readers a rapid view of the whole field of contemporary science. Here, again, his subject had the advantage of novelty. And although fewer people had any considerable knowledge of the latest advances in physics, chemistry, geology and other branches of experimental science than could have been expected to be familiar with the Linnaean system of botanical classification, Darwin was still on firm enough ground. To the cultivated amateur, the gentleman of independent means, the clergyman of slight professional pre-occupation, the eager and intelligent physician, the man of business who was yet of an inquiring turn of mind, "natural philosophy" had all the charm of a delightful constructional toy. It provided endless opportunities for investigation, experiment and discussion. Every branch of it offered chances of real discovery and completely new contributions. Everyone, with a little application, could master all that was known of a particular subject at the time, and could hope to go on independently from there. Science seemed, not only a fascinating pursuit in itself, but also the key to the future, which would unlock all the secrets of nature and give man complete dominion over the material world. The words scientist and optimist were then practically synonymous. Darwin's material was therefore promising, and he was eminently fitted to treat it to the best advantage.

Darwin was a man of the most vigorous powers of mind. He had an unquenchable thirst for information and instruction; he had amassed quantities of varied knowledge throughout his life; and he kept continuously abreast of the latest developments in every field. He read, considering that he was a busy professional man, an astonishing number of books and periodicals. He was not content, moreover, merely to absorb. He was of a notable independence; he could improve upon any theory that was put before him; he could elaborate any hypothesis; and he could produce a steady supply of original ideas and suggestions. He lived, too, among men of equal powers. His friends included distinguished scientists, inventors, writers, manufacturers. He was in personal contact with many leaders of thought, both English and foreign, outside his immediate circle. And he kept a firm grasp on every important question of the day. All this knowledge, this activity, this awareness, is reflected in his writings. His interest in science was never merely academic. Experiment, investigation, theorising, were part of his daily life, as they were part of the daily life of countless men of similar tastes. And since this was so, he was not ashamed of didacticism. The didactic tradition in English poetry was well established, and since he had something to say, there was no reason why he should not say it in verse, if he could. For although many people could perhaps equal Darwin in quantity of knowledge, although the age was of an encyclopaedic turn of mind, he had a distinguishing gift, the power to see all knowledge as a whole and to present it as a synthesis. He was keenly aware of the relevance of all scientific discovery and speculation to the conduct of human life. His verse is, moreover, essentially moral. This is apparent not only in his approach to questions such as the slave-trade. It informs his whole outlook. He assumes that man has an active desire to improve, not only his external environment, but also the society in which he lives. He sees men living in harmony, acting upon motives of benevolence and justice, occupied in the search for scientific truth and its application to practical problems, and seeking pleasure in literature and the arts. He is fully aware that this is not the present state of affairs, but he sees no reason why it should not become so. He has thus a guiding vision, a steady enthusiasm that never overleaps the bounds of good sense, and the ability to convey his convictions in an acceptable form. Much of what he had to say was familiar to the scientifically-minded reader; much else was of topical interest to the fashionable world. His subject-matter, on the whole, is concrete. Things, processes, personalities are presented to the imagination in steady succession. Darwin is writing in and for the real world of his own day, and the world approved. Later critics, living in different worlds, find it difficult to recapture the excitement with which The Botanic Garden, packed with contemporary reference and topical allusion, familiar in style, novel in theme, and expressing to the utmost the optimistic and liberal mood of the time, was received. They can only view, with a somewhat jaundiced eye, the unfortunate excesses of its style. It is only fair, however, that if Darwin is to be kept alive as a specimen of literary decadence, he should also be recognised as a pioneer in endeavour. He was attempting, in a spirit of true Humanism, to unite science and literature, to depict the life of man as a coherent whole. He could not know that the future history of science, running off into narrow and deep channels of specialisation, was to make this impossible in the way in which he visualised it. His own attempt was not successful. Even in his own day, the scientific material at his disposal could not be fitted into a literary mould. It overflowed, and had to be contained, or retained, in prose additions to the verse. And these prose additions, in themselves, make no pretence to literary form. The task was a very difficult one. Since Darwin's failure, there have been few attempts to repeat the undertaking, and no one has yet succeeded where he failed. On the whole, poetry has gone one way, and science has gone another. Both have become what would have seemed to Darwin's contemporaries esoteric cults, from which the amateur of no special qualifications other than that of interest has been excluded.

The intrinsic interest and value of the attempt he was making must therefore be the chief justification of any serious consideration of Darwin's poetry. The aim of this thesis is to sketch, in outline, the background against which he lived and wrote, to indicate the sources and inspiration of different parts of his work, and to venture an estimate of his aims and his achievements. This will involve investigation of his subject matter, its nature, its extent and Darwin's individual treatment of it, some attempt to assess the degree of his success or failure in presenting it in a verse form, and some inquiry into the development and expansion of his poetic purpose. The Temple of Nature is a long way from The Loves of the Plants. The transition was made in The Economy of Vegetation. This poem has nevertheless been treated first, since it was intended as the first part of the whole poem, The Botanic Garden. The Interludes placed between the cantos of the second poem have not been considered here, since their contents have already been dealt with, by Mr.J.V.Logan, in The Poetry and Aesthetics of Erasmus Darwin, and since familiarity with them is in no way essential to appreciation of the verse. Darwin's prose works, the Zoonomia and the Phytologia in particular, have been drawn upon where they throw light upon his poetry, and especially in connection with The Temple of Nature.

The theories of medicine and agriculture which the prose works contain are not discussed here, since both have a vast scientific background, impossible to indicate in a small space, and since neither has any considerable direct bearing upon the poetry. Nor has it been possible here to enter upon the question of possible precedents and influences in the field of scientific poetry. Mr.Logan has described the work of some of Darwin's fore-runners in England; and it seems likely that some inspiration may have been derived from France. The whole subject, however, is too large to be dealt with within the compass of this thesis. Indeed, Darwin's range was so wide, his sources so extensive, that the material presented here has necessarily been much compressed. One section has been treated at somewhat greater length than the rest. The Production of Life, the first canto of The Temple of Nature, contains much that concerns the theory of evolution by which Darwin is still known to the world of science, and it was felt that this important aspect of his thought and work required a fuller discussion than could be allotted to other topics. It is hoped that from the whole study will emerge a picture of the man in his setting and a view of his works against the contemporary background.

THE LIFE OF ERASMUS DARWIN

Erasmus Darwin died on April 18th 1802. Distinguished in the various scientific and literary circles in which he had moved, sought after as a physician and an authority on medicine, and famous as the author of The Botanic Garden, he was an obvious subject for the biographer. It is not surprising that, in an age much addicted to the art of biography, several of his friends felt impelled to record the events of his full and active life. Among these was Richard Lovell Edgeworth, mechanical inventor and writer on education. His daughter Maria informs us that her father was asked by the doctor's family to write a life of Darwin, but was forestalled by Miss Anna Seward[1]. Darwin's friend and pupil, Dewhurst Bilsborrow, had also contemplated a biography. He wrote to Miss Seward asking for the loan of any letters of Dr. Darwin in her possession. She replied that it was not in her power to assist, as correspondence between the doctor and herself had been infrequent.[2] Her own work, entitled Memoirs of the Life of Dr. Darwin, chiefly during his residence at Lichfield, with anecdotes of his friends and criticisms on his writings was published in 1804

---

(1) Memoirs of Richard Lovell Edgeworth, Esq., begun by himself and concluded by his daughter Maria Edgeworth, 1820 (3rd ed. 1844, p.397).

(2) Letters of Anna Seward, written between the years 1784 and 1807, 1811, Vol.VI, p.52.

and, since Mr. Bilsborrow's intention was never fulfilled, remains the only contemporary life of Darwin. At the time it caused some indignation among the doctor's family and friends. His son, Dr.Robert Darwin of Shrewsbury, protested that her account was in places both inaccurate and libellous, and in the Monthly Magazine for May, 1804,[1] Miss Seward retracted the most damaging of her remarks. In 1879, when a translation of Ernst Krause's book, The Scientific Works of Erasmus Darwin was published, a new life of Darwin, written by his grandson Charles, author of The Origin of Species, was prefixed to the translation. This contains some additional facts, and an attempt to correct some of the false impressions created by Miss Seward.

The most readable and extensive biography, Mr. Hesketh Pearson's Doctor Darwin, was published in 1930. This contains information derived from Miss Seward, from Charles Darwin, and from minor sources, includes many anecdotes of Darwin's personal life, and gives some account of the doctor's circle of friends. The following record, therefore, claims only to indicate the main outline of Darwin's life, and to present a general picture of the interests and activities out of which grew the material of his poetry.

---

(1) Monthly Magazine for 1804, Vol.I, p.378.

Erasmus Darwin, the fourth and youngest son of Robert Darwin of Elston Hall in the county of Nottingham, was born on December 12, 1731. From Chesterfield School he proceeded to St.John's College, Cambridge in 1750. He studied the classics, mathematics and medicine, took his B.A. degree, and in 1754 went to Edinburgh to continue his medical studies. Here he formed the first of those friendships which played such an important part in his later life. James Keir, at that time a student of medicine, afterwards took up a military career. On his retirement from the army he settled in Birmingham, took up the study of chemistry, translated Macquer's Dictionary of Chemistry, and embarked on the compilation of a Dictionary of Chemistry of his own, of which only the first part was published. He was a prominent member of the circle which included Darwin, Matthew Boulton, James Watt, Josiah Wedgwood, Richard Lovell Edgeworth and others whose names are better known to posterity than his own. In his day he enjoyed some reputation as a chemist.

In 1756 Darwin settled in Nottingham, intending to open a practice as a physician. Patients were few, however, and prospects uninviting, and after a short time he moved to Lichfield, carrying letters of introduction to Thomas Seward, Canon of the Cathedral. Here he was more fortunate. He quickly established a reputation for skilful diagnosis and successful treatment, and soon became widely respected for his forceful intellect and scientific knowledge. In 1757 he married Miss Howard, of the Cathedral Close, and soon afterwards bought a house, where he lived for the next twenty-four years. His eldest son, Charles, was born in 1758. Of the four succeeding children only Erasmus, born in 1759, and Robert, born in 1766, survived.

Miss Anna Seward, daughter of Canon Seward, who was only a child at the time of Darwin's arrival in Lichfield, records that to his house there soon resorted "a knot of philosophic friends, in frequent visitation".[1] These included Matthew Boulton, the manufacturer, whose great works at Soho were opened in 1762; the Rev. John Michell, a friend of Cambridge days; Josiah Wedgwood, founder of the manufactory at Etruria; Dr. William Small, Birmingham physician; Richard Lovell Edgeworth, who sought Darwin's friendship on account of the doctor's skill in mechanical invention, and his friend Thomas Day, author of Sandford and Merton; John Whitehurst of Derby, clockmaker and geologist; James Keir, who arrived in Birmingham about 1770; James Watt, who entered into partnership with Boulton in 1774; and Samuel Galton, Quaker manufacturer and amateur of the sciences.[2] It seems to have been at Boulton's suggestion

(1) Anna Seward, Memoirs of the Life of Dr. Darwin, 1804, p.16.
(2) Samuel Galton's daughter, Mary Anne, afterwards gave a hostile and unflattering account of Darwin and his visits to her father's house, in her autobiography. See Life of Mary Anne Schimmelpenninck, 1858, Vol. I.

that at some time fairly soon after Darwin's arrival in Lichfield there was founded an informal society for scientific experiment and discussion, which met once a month at the time of the full moon and which thus came to be called the Lunar Society. The members numbered eight or ten, and included, at different times, all those mentioned above, except Michell, who can have been only an occasional visitor to Lichfield, and Wedgwood, who was frequently present but not a regular member. The subjects discussed were chemistry, electricity, optics, mechanical invention and other sciences and applied sciences. One of the most distinguished members was Joseph Priestley, who took charge of a Dissenting congregation in Birmingham in 1780, there pursued the researches which had already brought him fame as a chemist, and was helped in his work, financially and in other ways, by Darwin, Wedgwood, and others of the circle.

The sciences, however, were not Darwin's only interest. He read widely in English poetry from Milton to his own day; he encouraged Miss Seward in her early attempts at verse-writing; and occasionally produced short poems of his own. Some of these are preserved in Miss Seward's biography of Darwin. About the middle of the decade between 1770 and 1780 Darwin made two new friends. Francis Noel Clarke Mundy, of Markeaton, and Brooke Boothby, of Ashbourne Hall, were both amateurs of literature, poets in their own right, and devoted admirers of Darwin. Mundy's The Fall of Needwood, published in 1808, and Boothby's volume of sonnets, written in memory of his daughter Penelope,[1] who died at the age of six, both contain eloquent tributes to Darwin's benevolence, medical skill, and poetic ability.

A few years before Darwin left Lichfield he and Mr. Boothby, together with a certain Mr. Jackson, proctor in the Cathedral jurisdiction, and according to Miss Seward "a turgid and solemn coxcomb",[2] formed a botanical society, for the purpose of translating into English the works of the Swedish botanist Linnaeus. No further recruits flocked to the society, to the disappointment of Darwin and his friends, but "Various observations, signed Lichfield Botanical Society, were sent to the periodical publications, and it was amusing to hear scientific travellers, on their transit over Lichfield, inquiring after the state of the botanical society there."[3] The translation proceeded, however, and in 1783 The System of Vegetables was published. It was followed in 1787 by The Families of Plants. In 1777, moreover, Darwin bought a piece of land just outside Lichfield, and planned out a botanic garden, in which, according to Miss Seward, the idea of his scientific poem was conceived. The garden at any rate provided its setting.

---

(1) Sorrows, sacred to the memory of Penelope. 1796. Sonnet IV. and Poetical Exercises No.18.
(2) Seward, op.cit., p.99.
(3) Ibid., p.100.

The years spent in Lichfield were not altogether untroubled. In 1770 his wife died, and his sister then kept house for him, and brought up his children. His eldest son, an intelligent boy, of tastes similar to Darwin's own, and on whom his father set great hopes, took up medicine, and after a brilliant start at Edinburgh, died suddenly in 1778, from poisoning set up in a cut received during a dissection. This was a heavy blow. In the same year, however, there came to Lichfield to consult Dr.Darwin, Mrs.Pole, wife of Colonel Chandos Pole, of Radburn, Derbyshire, with her children. Darwin cured the children, fell in love with Mrs.Pole and poured out his feelings in verse. In 1780 Mrs. Pole was left a widow, and after a suitable interval Darwin married her, and at her request moved to Derby in 1781. In the interval between the death of his first wife and his second marriage he had become the father of two illegitimate children. He gave the Misses Parker, as they were called, a good education, and in later years established them in a boarding school of their own, in a house at Ashbourne, overlooking the house of his friend Sir Brooke Boothby, who had succeeded to a baronetcy in 1789. The Misses Parker were on excellent terms with Darwin's family; he sent the daughters of his second marriage to the school; and in 1797 he published <u>A Plan for the Conduct of Female Education</u>, to advertise the education it provided.

During the years he had spent in the Cathedral city Darwin had built up a national reputation in medicine and a local reputation in half-a-dozen different fields. Miss Seward reports that he "withstood solicitations from countless families of rank and opulence, to remove to London",[1] and that "Patients resorted to him, more and more, from every part of the kingdom, and often from the Continent".[2] In spite of this, "While resident in Lichfield, to the priest and lay-vicars of its cathedral, and their families, he always cheerfully gave his advice, but never took fees from any of them. Diligently, also, did he attend to the health of the poor in that city, and afterwards at Derby, and supplied their necessities by food, and all sort of charitable assistance."[3] His hospitality, too, was unlimited, and "Generosity, wit, and science, were his household gods".[4] Nevertheless, of the details of Darwin's domestic life we know little. His letters are almost always concerned with intellectual and scientific pursuits, rarely with personal matters. His intellectual life, however, was vigorous.

As early as 1757 he contributed his first paper to the Royal Society, on electricity.[5] After the submission of a

---

(1) Ibid., p.151.
(2) Ibid., p.388.
(3) Ibid., p.5.
(4) Ibid., p.6.
(5). <u>Remarks on the Opinion of Henry Eeles, Esq.; concerning the Ascent of Vapour</u>. Philosophical Transactions. Vol.L. Part I. (1757). p.240.

second paper, in 1760,[1] he was elected a Fellow of the Royal Society, and contributed further papers in 1774 and 1778.[2] Of every branch of contemporary science he had a wide knowledge; in every one he kept up with current developments; and on every subject he had opinions and theories of his own. He read everything, philosophy, science, travels, history, fiction, poetry, and innumerable periodicals and journals. From 1771 he was engaged upon the composition of a medical treatise, the first volume of which was published under the title Zoonomia in 1794. The second volume followed in 1796. At intervals he wrote poetry, translated or supervised the translation of Linnaeus, worked in his botanic garden, discussed literature with Miss Seward, Sir Brooke Boothby and other friends of literary tastes, chemistry with James Keir and other members of the Lunar Society, ancient art and ceramics with Wedgwood, mechanics with Edgeworth, and anything else with anyone who was interested. Ideas on every subject poured from his active mind.

His activities were not interrupted by his removal to Derby. He was no longer able to attend meetings of the Lunar Society as often as he would have liked, but in 1784 he took the chief part in founding the ~~literary and~~ Philosophical Society of Derby, of which he was the first President. A list

---

(1) An uncommon Case of an Haemoptysis. Philosophical Transactions LI. Part II (1760). p.526.

(2) Experiments on Animal Fluids in the exhausted Receiver. Philosophical Transactions. LXIV. (1774). p.344.
A new Case in Squinting. Ibid., LXVIII. Part I. (1778) p.86.

of the original members, an account book, the catalogue of the Society's library, and a record of books borrowed are preserved in the Public Library of Derby. No record of meetings held, however, seems to have survived. Members, who were not confined to residents in Derby, included Sir Brooke Boothby, Mr.Jackson, Mr.William Strutt, a local manufacturer and a personal friend of Darwin, and, at a later date, Darwin's third son Robert, and Wedgwood's son John. The address delivered by Darwin at the Society's first meeting is preserved at Down House, Downe, Kent, the home of his grandson Charles Darwin.

At the same time Darwin planned and opened a public dispensary for the relief of the sick poor, which was supported by all the doctors and druggists in the town. In 1785 and 1787 he contributed further papers to the Philosophical Transactions.[1] And in 1789, after ten years of composition and revision, he published the second part of his scientific poem, The Loves of the Plants. A second edition was issued in 1790, and in 1791 the first part, The Economy of Vegetation, was published. The two parts together form The Botanic Garden. The poem brought him immediate fame and considerable financial profit. It was read and admired by a wide public, extravagantly praised by

---

(1) An Account of an artificial Spring of Water. Philosophical Transactions LXXV. (1785). p.1.
Frigorific Experiments on the Mechanical Expansion of Air. Ibid., LXXVIII. (1788), p.43.

Horace Walpole and by Darwin's personal friends, and imitated by Thomas Beddoes, with whom he had opened a correspondence and friendship about 1788. In 1792 Beddoes printed a poem entitled Alexander's Expedition down the Hydaspes and the Indus to the Indian Ocean, closely imitative of Darwin's work, both in the style of the verse and in the voluminous notes attached to the verse. The two men had many interests in common. Darwin encouraged Beddoes in his scheme for a Pneumatic Institution, and they exchanged letters on a variety of scientific and medical topics. Their scientific ideas and their political beliefs, for they were both advocates of liberty and supporters of the French Revolution, were burlesqued by an anonymous writer in a work entitled The Golden Age. A Poetical Epistle from Erasmus D-N, M.D. to Thomas Beddoes, M.D., which was for a time accepted as Darwin's. Darwin inserted a notice in The Derby Mercury, saying that he was not the author. This was in 1794.[1] In 1798 Darwin was again attacked. The Anti-Jacobin or Weekly Examiner of April 16th of that year contained a poem called The Loves of the Triangles, a ruthless parody of The Botanic Garden, and a loud condemnation of Darwin's scientific and political ideas. The work was received with delight, and was continued in two more numbers of the paper. It did not, however, deter Darwin from further poetic composition.

---

(1) The only known copy of this work is now in the Public Library at Derby.

In 1794 the first volume of the Zoonomia was published. This consists chiefly of an exposition of Darwin's own system of psychology, deriving from the tradition of Locke and Hartley. It also contains the theory of evolution which has caused its author's name to survive in histories of science. The second volume, published in 1796, is more closely concerned with medical practice. In 1797 the Plan for the Conduct of Female Education appeared; in 1800 Darwin published a comprehensive volume entitled Phytologia; or the Philosophy of Agriculture and Gardening; and at his death in 1802 his last poem, The Temple of Nature, was just completed. This was published in 1803.

In the meantime contacts with old friends were maintained; his reading and his interests were extended; he elaborated old theories and produced new ones; and he kept up one of the most successful medical practices in England. A second family was growing up round him, though he suffered a fresh blow in 1799, when his second son, Erasmus, drowned himself in a fit of melancholia. Anna Seward's remarks on Darwin's reception of the news of his son's death, in the Memoirs, aroused great indignation in the family; and it was this part of the work that she was obliged to retract. With his third son, Robert, now a prosperous physician in Shrewsbury, he maintained an exchange of medical news and opinion. Of the original group of friends, Dr. Small, John Whitehurst and

Thomas Day were dead. Joseph Priestley was living in exile in America, and Edgeworth was in Ireland. With the latter, however, Darwin regularly exchanged letters, and when Edgeworth was in England on occasional visits he went to Derby to see the doctor and his family.

In 1801 Darwin had a serious illness. He recovered and carried on, but his health was weakened, and on Sunday April 18, 1802 he died suddenly, as he was writing a letter to Edgeworth. He was buried in Breadsall Church near his home.

THE OPERATION OF THE ELEMENTS

In the Advertisement to The Botanic Garden Darwin explains that

> "In the first Poem, or Economy of Vegetation, the physiology of Plants is delivered; and the operation of the Elements, as far as they may be supposed to affect the growth of Vegetables."[1]

The physiology of plants, however, occupies only half a canto of the poem. The remaining three and a half cantos are devoted to the operation of the elements, though not to this only as far as it concerns the growth of plants. Darwin treats of subjects as diverse, as extensive, and as remotely connected with the main theme of the poem, as the history of the cosmos, the art of Josiah Wedgwood, the latest developments in chemistry and electrical science, the invention of the steam-engine, the significance of ancient mythology, and recent progress in meteorology. The last of these, together with the many subsidiary topics which arise out of it, is most directly related to the economy of vegetation, and is the subject of the present chapter. Each of the other principal subjects will require a somewhat detailed consideration, which will be reserved for later chapters. It is felt that this method will produce a clearer picture of Darwin's achievements than would be obtained from a survey

---

(1) E.V. Advertisement. p.[v].

of the poem from beginning to end, since the material is so various, and Darwin's treatment of it so discursive, that not only would it be difficult to pick out a continuous line of thought, but also much repetition and cross-reference would be entailed. An artificial division is more likely to preserve the basic unity of the poem.

A brief examination of the general plan of The Economy of Vegetation will indicate the basic unity in its design, and the discursive treatment of detail which is almost necessitated by Darwin's choice of framework. The scene is set, throughout the poem, in "a botanic garden about a mile from Lichfield."[1] Into this garden descends the Goddess of Botany. She is received by an assembly of Nymphs of Fire, Gnomes, Nymphs of Water and Sylphs, the inhabitants and representatives of the four elements of fire, earth, water and air. She addresses each group in turn, explaining to them the part played by the element to which they belong in the growth of plants and in other operations of nature. All the scientific information which the poem contains is thus put into the mouth of the goddess. The division into four cantos, corresponding to the four elements, however, involves some splitting up of subjects which might otherwise have been treated as a whole, some overlapping of poetic material

(1) E.V. I. 1.26, n.

and explanatory notes, and gives the impression of haphazard linking of topics. The disjointedness was undoubtedly due in part to the natural constitution of Darwin's mind, in part to his method and manner of composition; but it was also the result, to some extent, of the adoption of this framework.

The idea of the Rosicrucian machinery may have been derived immediately from The Rape of the Lock. The letter to Mrs. Arabella Fermor, prefixed to this work, seems a likely source of Darwin's statement that,

> "The Rosicrucian doctrine of Gnomes, Sylphs, Nymphs, and Salamanders, was thought to afford a proper machinery for a Botanic poem; as it is probable, that they were originally the names of hieroglyphic figures representing the elements."[1]

Darwin does not seem to have been indebted to the Rosicrucians for anything more than the personification of the elements. The link between Rosicrucian doctrine and hieroglyphics was probably forged by him. Beyond this, his general debt to the work of Pope suggests that the idea was a literary inspiration, and has little deeper significance. It is possible, too, that he was stimulated by a remark in the Polymetis of Joseph Spence, who had said:

> ".... if any modern poet was to form a new scheme for machinery, consisting of good and bad angels; or of any imaginary beings, by whatever names he might please to call them: our poets would have as full

(1) E.V. Apology. p.[vii].

> scope for introducing them, whenever they pleased, on the doctrine of particular providence, in the moral world; or on that thought in the Newtonian philosophy, which supposes all motion may possibly be occasioned by the immediate impulse of some spiritual being, in the natural; as the ancient poets had from the doctrine of Fate, or the will of Jupiter, interfering in all things."[1]

This suggestion, casually thrown out, may well have been noted by Darwin. Many of his most elaborate theories were built upon a slighter foundation. At any rate, the machinery he chose gave full scope to his powers of personification, and imposed a certain coherence upon the assorted subject-matter of the poem.

Some light is thrown upon the poem as a whole by a consideration of its opening lines. These, in their original form, were written, not by Darwin, but by Anna Seward. The circumstances are explained in the Memoirs of 1804.

> "About the year 1777", Miss Seward says, "Dr.Darwin purchased a little, wild, umbrageous valley, a mile from Lichfield, amongst the only rocks which neighbour that city so nearly. It was irriguous from various springs, and swampy from their plenitude. A mossy fountain, of the purest and coldest water imaginable, had, near a century back, induced the inhabitants of Lichfield to build a cold bath in the bosom of the vale. That, till the doctor took it into his possession was the only mark of human industry which could be found in the tangled and sequestered scene.
>
> .... The Doctor cultivated this spot,
> 'And Paradise was open'd in the wild.'

---

(1) Joseph Spence. Polymetis. 1747 (1755, 2nd ed; p.319).

> In some parts he widened the brook into small lakes, that mirrored the valley; in others, he taught it to wind between shrubby margins. Not only with trees of various growth did he adorn the borders of the fountain, the brook, and the lakes, but with various classes of plants, uniting the Linnean science with the charm of landscape."[1]

This was the place which provided the setting of The Botanic Garden. Miss Seward tells us:

> "Dr. Darwin restrained his friend Miss Seward's steps to this her always favourite scene till it had assumed its new beauties from cultivation. He proposed accompanying her on her first visit to his botanic garden, but a medical summons into the country deprived her of that pleasure. She took her tablets and pencil, and, seated on a flower-bank, in the midst of that luxuriant retreat, wrote the following lines, while the sun was gilding the glen, and while birds, of every plume, poured their song from the boughs."[2]

The lines which Miss Seward then quotes are almost, but not quite identical with the first fifty-eight lines of The Economy of Vegetation. She continues:

> "When Miss Seward gave this little poem to Dr.Darwin, he seemed pleased with it, and said, 'I shall send it to the periodical publications; but it ought to form the exordium of a great work. The Linnean System is unexplored poetic ground, and an happy subject for the muse. It affords fine scope for poetic landscape; it suggests metamorphoses of the Ovidian kind, though reversed. Ovid made men and women into flowers, plants, and trees. You should make flowers, plants, and trees, into men and women. I', continued he, 'will write the notes, which must be scientific; and you shall write the verse'."[3]

Miss Seward objected that not only did she lack the necessary botanic knowledge, but also the subject was hardly

---

(1) Anna Seward. Memoirs of the Life of Dr.Darwin. 1804. p.125.
(2) Ibid., p.127.
(3) Ibid., p.130.

proper for a female pen. She felt, however, that it was eminently suited "to the efflorescence of his own fancy."[1] Darwin eventually agreed to the undertaking, "and very soon began his great poetic work."[2] This was in 1779. Miss Seward gives us some idea of his method and manner of composition:

> "The verse corrected, polished, and modulated with the most sedulous attention, the notes involving such great diversity of matter relating to natural history; and the composition going forward in the short recesses of professional attendance, but chiefly in his chaise, as he travelled from one place to another, the Botanic Garden could not be the work of one, two or three years; it was ten from its primal lines to its first publication."[3]

Although we cannot place complete reliance upon the accuracy of every detail of Miss Seward's recollections, this account does furnish a general picture of the genesis of the poem. It suggests that from the first Darwin regarded the Linnaean system as his main theme, and the explanatory notes as an integral part of the work. As the poem progressed the scheme was evidently extended to include the physiology, as well as the classification, of plants, and then further elaborated, so that eventually it dealt with the environment of plant life and the operation of the elements in general. It was further made the repository of material which was not relevant to the botanical theme in any

(1) Ibid., p.131.
(2) Ibid., p.132.
(3) Ibid., p.167.

way, but which could be made to provide relief to the strictly scientific subject-matter.

The lines originally composed by Miss Seward were reserved as the introduction to the complete work, but were unfortunately printed without any acknowledgement to their author. This tactless mistake earned Miss Seward's reproaches.[1] Furthermore, Darwin's failure to explain their origin makes them slightly obscure in their final context in the poem, which opens with an address to the reader, spoken by the Genius of the Place, who invokes the Botanic Goddess, in lines added by Darwin to Miss Seward's version.[2] Darwin then continues, quoting Miss Seward almost exactly:

"Thus spoke the GENIUS, as He stept along,
And bade these lawns to Peace and Truth belong;
Down the steep slopes He led with modest skill
The willing pathway, and the truant rill,
Stretch'd o'er the marshy vale yon willowy mound,
Where shines the lake amid the tufted ground,
Raised the young woodland, smooth'd the wavy green,
And gave to Beauty all the quiet scene.-"[3]

These lines were intended by Miss Seward to refer to Darwin himself. The poem was a compliment on his skill in the art of improving landscape. The reader of The Economy of Vegetation, however, may wonder why the Genius is introduced at all, and why he summons the Botanic Goddess to a

---

(1) See Letters of Anna Seward: written between the years 1784 and 1807. ed. A.Constable. 1811. Vol.III. p.154.
(2) E.V. I. ll.44-50.
(3) E.V. I. ll.51-58.

place only just redeemed from its natural wildness, which as yet can hardly be called a botanic garden. The fact that Darwin overlooked, or disregarded, both his debt to Miss Seward, and the difficulties involved in the adaptation of her poem to his own use, is some indication that strict coherence and logical sequence were not one of his main concerns. He used what lay ready to hand, without exerting himself to assimilate it fully into the main structure of his work.

We must now consider in somewhat closer detail Darwin's treatment of the operation of the elements. Of the four cantos only the third contains no themes of special importance, so that this consideration will comprise an indication of the general outline of the poem, with discussion of particular points connected with meteorology and its relation to plant life, and a fuller analysis of the third canto, as an illustration of Darwin's method of composition.

Having laid the scene, Darwin begins at the beginning with an explanation of the part played by Fire in the evolution of the cosmos. Then follows an account of natural phenomena to be observed in the sky, for which the Nymphs of Fire are also responsible. The Botanic Goddess speaks:

"ETHEREAL POWERS! YOU chase the shooting stars,
Or yoke the vollied lightenings to your cars,
Cling round the aërial bow with prisms bright,
And pleased untwist the sevenfold threads of light;
Eve's silken couch with gorgeous tints adorn,
And fire the arrowy throne of rising Morn.

-Or, plum'd with flame, in gay battalion's spring
To brighter regions borne on broader wing;
Where lighter gases, circumfused on high,
Form the vast concave of exterior sky;
With airy lens the scatter'd rays assault,
And bend the twilight round the dusky vault;
Ride, with broad eye and scintillating hair,
The rapid Fire-ball through the midnight air;
Dart from the North on pale electric streams,
Fringing Night's sable robe with transient beams."[1]

The verse is amplified and explained by footnotes and Additional Notes. Darwin puts forward the theory that beyond the terrestrial atmosphere there is a "supernatant atmosphere of inflammable air", or hydrogen, the gas discovered by Henry Cavendish.[2] He adds observations on the duration of twilight.[3] An Additional Note[4] on primary colours explains Newton's theory of the rainbow, records experiments in optics performed by his friend Samuel Galton, and refers the reader to a paper on optics written by his son Robert Darwin, and published in the <u>Philosophical Transactions</u> for 1786. Another Additional Note, on coloured clouds,[5] explains the refraction of sunlight and accounts for the colours of morning and evening skies; it also includes personal observation and anecdote relevant to the subject. All these notes

(1) E.V. I. ll.115-30.
(2) E.V. I. l.123, n.
(3) E.V. I. l.126, n.
(4) E.V. Add. Note II. For Robert Waring Darwin (the younger), <u>New Experiments on the Ocular Spectra of Light and Colours</u>, see <u>Philosophical Transactions</u> LXXVI (1786) p.313. The paper was reprinted in the first volume of the <u>Zoonomia</u>, 1794. (2nd ed, 1796. Sect.XL. p.538).
(5) E.V. Add. Note III.

consist of quotations from appropriate authorities, reference to current scientific theories of the day, and Darwin's own additional suggestions and conjectures. The total mass weighs down the verse very heavily. The Additional Note on meteors,[1] however, demands even closer attention from the reader, since it contains a complete theory of the origin of lightning, shooting stars, fireballs and the northern lights. Interest had been focussed upon these phenomena since Benjamin Franklin, earlier in the century, had demonstrated the electrical nature of lightning. Then, on the night of August 18th, 1783, a large "fireball" or meteor had been seen in the sky. Eye-witnesses in all parts of England had recorded their observations and sent them to the Royal Society, and in the Philosophical Transactions for 1784, Charles Blagden published a selection of those accounts which he considered most informative, together with the conclusions which he had himself drawn from the facts.[2] Darwin uses Blagden's paper as the starting point for his own reasonings concerning meteors, having first explained lightning, very briefly, according to Franklin's theory. He quotes the main facts concerning the fireball of 1783 from Blagden, draws upon a description of another fireball given by John Pringle in the Philosophical Transactions for 1759,[3]

(1) E.V. Add. Note I.
(2) Charles Blagden. An Account of some late fiery Meteors; with Observations. Philosophical Transactions. Vol.LXXIV. (1784). p.201.
(3) John Pringle. Some Remarks upon the several Accounts of the fiery Meteor (which appeared on Sunday the 26th November, 1758), and upon other such Bodies. Philosophical Transactions. LI. Part I. (1759). p.259.

and then develops his own theory from suggestions put forward by Blagden.

In 1759, when Pringle's paper was published, prevailing opinion attributed fireballs to the combustion of sulphureous vapours arising from the earth, although it had already been suggested that since lightning had been shown to be of electrical origin, other phenomena might be explained on the same principle. Pringle rejected both these theories, and favoured the idea that fireballs consisted of collections of matter formed by the fortuitous concourse of atoms in the atmosphere. By 1783, however, electricity had gained ground, and Blagden enquired:

> "What then can these meteors be? The only agent in nature with which we are acquainted, that seems capable of producing such phaenomena, is electricity."[1]

He then decided that fireballs were masses of electric fluid, attracted or repelled, and thus given a determined course, by the magnetism of the earth. Shooting stars were small fire-balls, lower in the atmosphere, and because more exposed to the action of extraneous causes, unaffected by the earth's magnetism. This explained their irregular course. Blagden then allotted electrical phenomena to four regions of the atmosphere. In the lowest region was

---

(1) Blagden, op.cit., p.224.

produced lightning; higher than this, shooting stars; and in still loftier region, fireballs; and above all these, the aurora borealis. Since Franklin had put forward a convincing electrical theory of the northern lights, Blagden's solution of the whole problem was pleasingly simple.

Darwin, however, was not content to accept it without qualification. He suggested three regions of the atmosphere, in which were produced four kinds of meteors, lightning, shooting stars, fireballs and northern lights. For lightning, he followed Franklin. His explanation of shooting stars was substantially the same as Blagden's. When he came to fire-balls, however, he hazarded a conjecture of his own. He suggests that these were due to a ball of electricity passing along the line at which the common atmosphere met the superior atmosphere of hydrogen, setting fire to the common air and the hydrogen as it travelled. The fire would differ in colour according to the proportions in which the two airs were mixed. It would move in a determined course, because attracted by the eruption of a volcano. Attribution of volcanic eruptions to electricity was fairly common at the time. Fire-balls belonged to the same region of the atmosphere as the northern lights, and both phenomena were due to the same cause. But the electricity of the northern lights was not attracted, and did not, therefore, pursue a defined course. To support the theory of a combustion of a mixture of gases Darwin draws on another paper from the Philosophical Transactions, entitled Observations and Experiments on the Light of Bodies in a State of Combustion, contributed by the Rev.M.Morgan to the volume for 1785.[1] He adds a summary of Franklin's theory of the northern lights.

The Additional Note on meteors is thus a complex structure. It rests more on hypothesis than on observed fact or scientific deduction, but is interesting as a reflection of contemporary ideas on the whole subject of luminous appearances in the sky.

Darwin then surveys comets, fires in the centre of the earth, phosphorus and other luminous substances, the statue of Memnon at Thebes, luminous plants and animals, and other things and phenomena connected with heat or light. The topics are varied, and the transitions rapid. Eventually he arrives at vegetation and its relation to Fire. The Botanic Goddess directs the Nymphs to summon the Vernal Hours, to release the Western Wind from bondage, and to overthrow the Fiend of Frost. To these commands are appended footnotes on the prevailing winds of this country[2] and on the cause of the injury done to vegetation by frost.[3]

---

(1) Vol.LXXV. p.190.
(2) E.V. I. l.430, n.
(3) E.V. I. l.439, n.

The first of these is treated at greater length in an Additional Note[1] on winds, attached to the fourth canto of the poem. The second topic is also further developed in an Additional Note,[2] which contains an abundance of information, culled from a variety of sources, on ice, frost, snow, and their effects on living things. None of this information appears in the verse. Instead, we have a description of a whale-hunt. The Goddess then proceeds;

> "Pervade, PELLUCID FORMS! their cold retreat,
> Ray from bright urns your viewless floods of heat;
> From earth's deep wastes electric torrents pour,
> Or shed from heaven the scintillating shower;
> Pierce the dull root, relax its fibre-trains,
> Thaw the thick blood, which lingers in its veins;
> . . . .
> NYMPHS! with sweet smile each opening flower invite,
> And on its damask eyelids pour the light."[3]

Footnotes explain the necessity of light to vegetation, with a theory of its effects which anticipates part of Darwin's theory of plant physiology given in a later Additional Note,[4] and provide evidence of the influence of electricity in forwarding the germination and growth of plants.[5] Again, however, facts and theories are confined to the notes. The verse contains only slight references

---

(1) E.V. Add. Note XXXIII. For discussion of this, see below, p.59, ff.
(2) E.V. Add. Note XII.
(3) E.V. I. ll.461-66; 471-72.
(4) E.V. I. l.462, n. cf. Add. Note XXXIV. See The Physiology of Plants, p.195.
(5) E.V. I. l.463, n.

to the scientific commentary. It may be noticed, too, that Darwin refers in the lines quoted above, to the vegetable "blood" and "veins". These words are not used only in a figurative sense; but the reader is obliged to wait until he reaches the Additional Notes attached to the fourth canto[1] for the explanation of the precise meaning of these terms in Darwin's theory of plant physiology.

The remaining part of the canto contains two passages which require comment. Darwin suggests that icebergs might be navigated from northern regions into southern oceans, and the climate of the earth thereby rendered more temperate. The idea, as the footnote indicates, was probably suggested by a passage in Richard Bradley's <u>General Treatise of Husbandry and Gardening</u>; as expressed in verse it is picturesque:

> "On ice-built isles expand a thousand sails,
> Hinge the strong helms, and catch the frozen gales;
> The winged rocks to feverish climates guide,
> Where fainting Zephyrs pant upon the tide;
> . . . .
> NYMPHS! veil'd in mist, the melting treasures steer,
> And cool with arctic snows the tropic year."[2]

This task, Darwin feels, would be more worthy of the nations of the northern hemisphere than the "destroying their sea-men and exhausting their wealth in unnecessary wars",[3] in which they are only too ready to engage. In

(1) See below, <u>The Physiology of Plants</u>, for discussion of the theories set out in Add.Notes XXXIV-XXXIX.
(2) E.V. I. ll.529-32; 541-42 (The numbering of the lines is inaccurate here.). cf. Richard Bradley. <u>A General Treatise of Husbandry and Gardening</u>. 1726. Vol.II. p.437.
(3) E.V. I. l.529, n.

his mind, the pursuits of science and the conduct of politics are closely connected; both activities should be expressions of man's desire and effort to improve the conditions of life, material and moral. His own pronouncements on politics are confined to broad questions. He is concerned with war, liberty, slavery, the freedom of the press. On these, he speaks as a humanist and a humanitarian.

From icebergs Darwin turns to the Solstice. In a footnote he suggests that since the water which he supposes to be "dissolved" in the atmosphere is also supported by electricity, a withdrawal of the electricity, effected by numerous pointed rods erected high in the air, like lightning conductors, might induce rain where it was needed.[1] This method of producing rain artificially is compared to the feat performed by Elijah on Mount Carmel. The simile may have been suggested by a reference to the story in a passage of James Bruce's Travels to discover the source of the Nile,[2] from which Darwin had quoted in a footnote attached to a line in his account of icebergs.[3] Bruce was a friend of the Galton family, and it is at least possible that Darwin may have received a copy of the book from them,

---

(1) E.V. I. 1.551, n.
(2) See James Bruce. Travels to discover the source of the Nile in the Years 1768, 1769, 1770, 1771, 1772, and 1773. 1790. Vol.III. p.669. (Bruce gives Elisha. Darwin has Elijah, correctly. See I. Kings. XVIII. 42-46).
(3) E.V.I. 1.545, n. cf. Bruce, op.cit., Vol.III. p.670.

for we know that Mrs Galton presented a copy to Joseph Priestley. In any case, it was one of the most eagerly read and generally discussed publications of 1790, and it was added at some time to the library of the [redacted] Philosophical Society of Derby. If, as seems almost certain, Bruce was the source of Darwin's verse-account of Elijah's production of rain, it can be seen that composition of The Economy of Vegetation continued after the publication of The Loves of the Plants, and that Darwin made full use of new material which offered itself for poetic treatment.

The first canto, although its contents are varied, includes more that is directly relevant to the effects of the elements on the growth of plants than do the others. Of the second, little need be said here, since the greater part of it is devoted to an exposition of geogony and geological theory, which must be dealt with separately.[1] Darwin does not attempt any explanation of the part played by earth, or mineral substances in plant nutrition, although experiments in this field had been carried out by Francis Home[2] and others. He restricts himself to a general appeal to the Gnomes to resist the damage done to the land by floods to nourish the plants, and to protect them from the depredations of worms and insects. He does, however, throw out one

---

(1) See below, The Ratiocination of Philosophy, 1) Cosmogony, 2) Geology.
(2) See Francis Home. The Principles of Agriculture and Vegetation. 1757.

notable conjecture:

> "The immense quantity of carbonic acid, which exists in the many provinces of lime-stone, if it was extricated and decomposed would afford charcoal enough for fuel for ages, or for the production of new vegetable or animal bodies."[1]

This idea is developed in the Phytologia,[2] where Darwin discusses plant nutrition at some length.

In this canto the growth of plants was obviously not Darwin's main interest. He was chiefly concerned with the geological theme, which is sustained and developed in detail. In contrast, the third canto presents a variety of topics, ranging from the circulation of water to fire-extinguishers, from the nature of warm springs to elegies on the deaths of personal acquaintances. All the subjects introduced have some connection with water; few of them are directly relevant to plant growth.

The opening lines, however, are decorous enough. The Argument explains the circulation of water:

> "Steam rises from the ocean, floats in clouds, descends in rain and dew, or is condensed on hills, produces springs, and rivers, and returns to the sea."[3]

In verse, the Goddess addresses the Nymphs of Water:

"YOUR buoyant troops on dimpling ocean tread,
Wafting the moist air from his oozy bed,
AQUATIC NYMPHS! - YOU lead with viewless march
The winged vapours up the aerial arch,
On each broad cloud a thousand sails expand,
And steer the shadowy treasure o'er the land,

---

(1) E.V. II. 1.523, n.
(2) See Phytologia. 1800. Part II. Sect.X. Manures, or the Food of Plants.
(3) E.V. Argument of the Third Canto. p.111.

Through vernal skies the gathering drops diffuse,
Plunge in soft rains, or sink in silver dews.-
YOUR lucid bands condense with fingers chill
The blue mist hovering round the gelid hill;
In clay-form'd beds the trickling streams collect,
Strain through white sands, through pebbly veins direct;
Or point in rifted rocks their dubious way,
And in each bubbling fountain rise to day.
NYMPHS! YOU then guide, attendant from their source,
The associate rills along their sinuous course;
. . . .
Onward YOU pass, the pine-capt hills divide,
Or feed the golden harvests on their side;
The wide-ribb'd arch with hurrying torrents fill,
Shove the slow barge, or whirl the foaming mill.
OR lead with beckoning hand the sparkling train
Of refluent water to its parent main, [1]
. . . .

This, in outline, is fairly clear. It combines scientific explanation, couched in conventional poetic diction, with some indication to the reader of the relevance of scientific theory to the practical conduct of agriculture and transport. Unfortunately the progress of the verse is delayed by an Additional Note[2] on evaporation, footnotes[3] on clouds, snow, hail, dews and mist, and an Additional Note[4] on the origin of springs. These notes reflect the developments of scientific meteorology of the preceding

---

(1) E.V. III. ll. 11-26; 37-42.
(2) E.V. Add. Note XXV.
(3) E.V. III. 1.15, n.; 1.18, n.; 1.20, n.
(4) E.V. Add.Note.XXVI. This Note consists chiefly of material from the two papers which Darwin contributed to the <u>Philosophical Transactions</u> for 1785 and 1788. For the origin of springs, see <u>An Account of an artificial Spring of Water</u>. Vol.LXXV. (1785). p.1. For the coldness of the summits of mountains see <u>Frigorific Experiments on the Mechanical Expansion of Air</u>. LXXVIII. (1788).p.43.

century, Darwin's reading in meteorological works, and his own observation and experiment. Full of interest for the historian of science, they constitute a serious obstacle to the reader of poetry. Thus, to the first four lines of the passage is appended a lengthy demonstration of the facts that heat is the principal cause of evaporation, and that water-vapour consists, according to the theory of Lavoisier, of water dissolved in the matter of heat. This involves a discussion of whether water may also be dissolved in air, whether electricity has any effect upon evaporation and condensation, and why the barometer sinks before rain. The Additional Note[1] which contains this material appears to be based on the chapter on evaporation in the Essais sur l'Hygrométrie of H.B. de Saussure, published in 1783. Darwin also makes use of James Hutton's Theory of Rain, which had appeared in the Transactions of the Royal Society of Edinburgh in 1788. He may have had in mind, too, Hugh Hamilton's Philosophical Essays, the first of which was entitled The Ascent of Vapours. The Note is, in fact, an extremely complex piece of work. It contains one notable

---

(1) Darwin's argument that heat is the principal cause of evaporation seems to be based on Essai III, Théorie de l'Evaporation, of H.B. de Saussure's Essais sur l'Hygrométrie. 1783. For James Hutton's Theory of Rain, see Transactions of the Royal Society of Edinburgh, 1788. Vol.I. Part II. I. Papers of the Physical Class. II. p.41. Hugh Hamilton argues that evaporation is a solution of water in air, in The Ascent of Vapours. Philosophical Essays. 1767. (3rd. ed. 1772).

inquiry. This is whether there are any exhalations occasionally diffused in the atmosphere which may enter into chemical combination with water-vapour, and so cause precipitation of the water, or rain. Chemistry is thus applied to the solution of meteorological problems; though here again, the suggestion is conjectural, and not based on scientific deduction.

The circulation of water in itself required little or no explanation at this date, and is referred to only incidentally in the notes. The idea, however, represents one of the meteorological triumphs of the seventeenth century. In 1690 Edmund Halley had presented to the Royal Society An Account of the Circulation of the Watry Vapours of the Sea, and of the Cause of Springs,[1] in which he explained that vapours, raised by evaporation from the sea, are carried over the land until they come into contact with the cold tops of mountains, where they condense into mists, sink into the earth and form springs of water, which join into streams, rivers, and so return to the sea. This theory gradually replaced the older belief, that the water of the sea in some way percolated through the earth, and back to the mountain tops where springs were formed. By 1790 the newer explanation was a commonplace. Nevertheless, it is

(1) Philosophical Transactions. XVII (1691). p.468.

instructive to compare Darwin's treatment of the subject with that of Thomson in The Seasons.[1] Darwin takes Halley's theory for granted. Thomson, as Mr. A.D.McKillop has shown,[2] was aware of Halley's work, but in 1730 inclined to the older opinion. By 1744, however, he had abandoned percolation and accepted evaporation. His direct source for the passage on the circulation of water in the 1744 edition of The Seasons was the Spectacle de la Nature of the Abbé Pluche,[3] which was known to Darwin, and which may have helped to suggest the description in The Economy of Vegetation.[4] Darwin's method, however, differs essentially from Thomson's. The earlier poet, writing in a serious, meditative vein, describes circulation in terms more strictly scientific than Darwin, the avowed poet of science. Thomson's account, detailed, didactic, is put forward as an argument from design. Darwin's tone is altogether lighter. The teleological note is lacking; the verse is elegant rather than informative; and scientific detail is confined to the notes. Thomson had provided eminently respectable

(1) Autumn. ll.736-834.(1746). See. The Complete Poetical Works of James Thomson. ed. J.Logie Robertson. 1908. (Oxford). pp.159-62.
(2) See A.D. McKillop. The Background of Thomson's Seasons. (University of Minnesota Press). 1942. pp.76-88.
(3) Noël Antoine Pluche. Spectacle de la Nature; or, Nature Display'd. Translated Samuel Humphreys. 1733 (8th ed. 1757. Vol.III. Dialogue XXI. p.84. The Ascent of Vapours from the Sea.).
(4) E.V. III. ll.19-24.

precedent for poetic treatment of the subject, but his failure in itself constituted a justification of Darwin's method. The failure of this, in its turn, suggests that verse is not a fit medium for the communication of scientific fact.

The circulation passage concludes with a simile in which the whole process is compared to the circulation of the blood in the human body. The germ of the idea may have been Halley's comparison of streams descending from mountains to "so many Veins of the Macrocosm."[1] Darwin's comparison, at any rate, is facilitated by the contemporary usage and connotations of the word "urn", which serves him here for the heart, and by such conventional phrases as "sanguine streams" and "vermil rills".

Having returned the water to the sea, Darwin allows himself to digress. He enters upon a decorative account of various sea-animals, described from different sources quoted in the notes.[2] Newton's theory of the tides is mentioned in passing and explained in more detail in a footnote.[3] Benjamin Franklin's experiments with oil on water are referred to briefly and described fully in an Additional Note.[4] The reader's attention is drawn to

(1) Halley, op.cit. p.470.
(2) E.V.III. ll.57-94, and notes.
(3) E.V. III. ll.59-62 and l.61, n.
(4) E.V.III. ll.87-88 and l.87, n. Add.Note XXIX. Most of the information given in this note can be found in, <u>Of the Stilling of Waves by Means of Oil; Extracted from Sundry Letters between Benjamin Franklin, LL.D.,F.R.S.</u>

/William

Captain Cook's account of coral-reefs;[1] and the Maelstrom is described and explained from an article in the Universal Museum for 1763[2]. All this is evidence of Darwin's wide interests and extensive reading; but it has little reference to the growth of plants.

We are suddenly returned to the subject of rivers. Darwin explains that another source of rivers is from beneath glaciers. The heat of the earth melts the snow and ice which lies in contact with it. And the ice on the surface of the glaciers evaporates, even in frosty weather, by "dissolving" in air. Thus the Nymphs of Water pervade the realms of Frost:

"Where round dark crags indignant waters bend
Through rifted ice, in ivory veins descend,
Seek through unfathom'd snows their devious track,
Heave the vast spars, the ribbed granites crack,
Rush into day, in foamy torrents shine,
And swell the imperial Danube or the Rhine.-"[3]

At this point Darwin strays, via the Tiber, into a meditation upon the ruins and lost glory of Rome. Then, by an abrupt transition, he enters upon an account of the monsoons as the cause of the rise of the Nile. From Egypt the reader is swept to Iceland, where the boiling fountain

---

(Footnote Contd. from previous page).
William Brownrigg, M.D., F.R.S. and the Reverend Mr. Farish. Read at the Royal Society, June 2, 1774. (1774). Franklin had discussed the subject with Darwin. See E.V. Add. Note XIII. p.25.

(1) E.V. III. 1.90, n.

(2) E.V. III. 11.95-102, and Add. Note. XXI. Darwin's references to the Memoirs of the Swedish Academy of Sciences, and Pontoppiden's Natural History of Norway are qhoted from the article in the Universal Museum for 1763. p.131.

(3) E.V. III. 11.113-18.

of Griesar had recently been destroyed by an earthquake. This in its turn leads to a description of the warm springs of Buxton, with an explanation, given in the footnote,[1] of their origin. The footnote is a recapitulation of information and argument which Darwin had advanced in The Loves of the Plants,[2] and which he had also contributed, in the form of a letter, to James Pilkington's View of the Present State of Derbyshire, published in 1789.[3] In the letter, which is dated February 5th, 1788, Darwin argues against the popular theory that warm springs in this country acquire their heat from the chemical decomposition of pyrites near the surface of the earth, and suggests that they are produced by steam, raised by subterraneous fires and condensed between the strata of mountains. Pilkington, introducing the letter to his readers, commented:

> "The respectable name of the writer, I am persuaded, will be sufficient to excite the curiosity and attention of the public, and from the novelty and ingenuity, which appear in some of the remarks, it may be presumed, that they will not be disappointed in their expectations."[4]

It would seem that the writing of this letter may have suggested the inclusion of the theory in The Loves of the Plants. Then, while writing The Economy of Vegetation, Darwin found occasion to re-introduce the subject of warm

---

(1) E.V. III. l.166, n.
(2) L.P. IV. l.179, n.
(3) James Pilkington. A View of the Present State of Derbyshire. 1789. Vol.I. p.256.
(4) Ibid., p.255.

springs, repeated his argument in brief, referred his readers to the relevant note in the earlier poem, and remarked:

> "For further proofs on this subject the reader is referred to a Letter from Dr.Darwin in Mr.Pilkington's View of Derbyshire, Vol.I. p.256."[1]

Since both parts of The Botanic Garden was published anonymously, the reader was not to know that its author and Dr.Darwin were one and the same. The repetitions, however, suggest either a steady zeal for the propagation of scientific theory, or a most economical use of poetic material and comment.

It is to Buxton that the Duke of Devonshire leads

"Graces and Loves from Chatsworth's flowery meads,"[2]

and Darwin takes the opportunity to compliment the duke upon "the magnificent and beautiful crescent, and superb stables" which he has lately erected, and "the plantations with which he has decorated the surrounding mountains."[3]

> "Here oft her LORD surveys the rude domain,
> Fair arts of Greece triumphant in his train;
> Lo! as he steps, the column'd pile ascends,
> The blue roof closes, or the crescent bends;
> New woods aspiring clothe their hills with green,
> Smooth slope the lawns, the grey rocks peep between;
> Relenting Nature gives her hand to Taste,
> And Health and Beauty crown the laughing waste."[4]

---

(1) E.V. III. 1.166, n.
(2) E.V. III. 1.170.
(3) E.V. III. 1.193, n.
(4) E.V. III. 11.193-200.

Returning temporarily to "rills and rivers", Darwin explains the chemical composition of water, ornaments his explanation with a long simile describing the union of Jupiter and Juno, suggests that in the atmosphere hydrogen and oxygen are probably perpetually combining to form rain, and notes, in half a sentence devoted to the growth of vegetables, that there is a decomposition of water in plant vessels.[1] There follows another decorative picture, perhaps inspired by the art of Josiah Wedgwood. Darwin addresses the Nymphs of Aquatic Taste, and draws a word-picture, unhampered by a single explanatory note, of a Nereid on her sea-horse.[2] The passage has no immediate relevance to the main theme of the canto; it may have been written for its own sake, and inserted in the poem in the most suitable context.

At this point in the canto there is an abrupt change of tone. The Gothic note is heard, as we are taken along the river Derwent;

> "Where by tall groves his foamy flood he steers
> Through ponderous arches o'er impetuous wears,
> By DERBY'S shadowy towers reflective sweeps,
> And gothic grandeur chills his dusky deeps;"[3]

(1) E.V.III. ll.201-260. For discussion of this passage see <u>The Ratiocination of Philosophy</u> (3) <u>Chemistry</u>, p.126 and <u>The Heathen Mythology</u>. p.180
The decomposition of water in plant vessels, mentioned in the note attached to line 204, has already been noted by Darwin, E.V.I.l.462,n. (see above, p.37). It is explained in E.V.Add.Note XXXIV. (See below, <u>The Physiology of Plants</u> p.195). These scattered references are a good illustration of Darwin's mode of composition and compilation.
(2) E.V.III. ll.277-301. See <u>Wedgwood, Friend of Art</u>, p.144
(3) E.V.III. ll.301-304 (The numbering of the lines has gone astray again here).

to the tomb of Milcena, who, as a note explains, was Mrs. French, "a lady who to many other elegant accomplishments added a proficiency in botany and natural history."[1] These interests Mrs. French had pursued on the banks of the river:

> "Oft with sweet voice She led her infant-train,
> Printing with graceful step his spangled plain,
> Explored his twinkling swarms, that swim or fly,
> And mark'd his florets with botanic eye.-"[2]

The link with the main theme is tenuous. The passage is essentially a personal tribute, for Millicent French, who had died in 1789, was the sister of Darwin's friend Francis Mundy. A reflection upon the transitoriness of beauty, which is pathetic in tone, rather than moral, as Miss Seward later described it, leads into an epitaph of four quatrains, spoken by Mrs.French's husband. This epitaph, however, was "omitted by mistake,"[3] from the main body of the verse, and was placed at the end of the poem. Commenting upon the elegy as a whole, Miss Seward said:

> "There is a tender strain of morality in this passage; but the annexed epitaph on Mrs.French, however beautiful as poetry, is by no means fit for it's originally proposed situation, a tombstone in the great church at Derby."[4]

The unsuitability of the lines for a tombstone, which was no doubt apparent to others besides Miss Seward, probably accounts for their presence in <u>The Economy of</u>

---

(1) E.V.III. 1.308, n.
(2) E.V.III. 11.309-12.
(3) See <u>Verses omitted by mistake</u>: E.V. p.212.
(4) Anna Seward. <u>Memoirs of the Life of Dr.Darwin</u>. 1804. p.248.

Vegetation, where they were evidently included as an afterthought, but where they follow quite naturally upon the more general elegiac passage.[1]

Another elegy, and another personal tribute, follows. James Brindley, the canal engineer, who was a friend of Josiah Wedgwood, and had supported the potter's scheme for the Trent-Mersey canal, had died of diabetes in 1772. Darwin, called in after other doctors had failed, had diagnosed the disease, but had been unable to arrest its progress. Writing to Wedgwood on September 30th, 1772, Darwin had said:

> "Your Letter gave me most sincere grief about Mr. Brindley, whom I have always esteem'd to be a Great genius, & whose loss is truly a public one. I don't believe he has left his equal. I think the various Navigations should erect him a monument in Westminster Abbey, & hope you will at a proper Time give them this Hint. ..... And any Circumstances that you recollect of his Life should be wrote down, & I will sometime degest them into an Eulogium. These men should not die, this nature denys, but their Memories are above her malice - Enough!"[2]

---

(1) Francis Mundy replies to Darwin's tribute to his sister in an Address to the River Darwent, which can be found prefixed to the 4th edition of The Economy of Vegetation (1799).
And Millicent French's son, R.N.French, wrote Elegiac Verses. To the memory of Erasmus Darwin, in which he said,

> "Milcena's son in grateful verse repaid
> (O debt! uncancell'd by his humble lays)
> The tender strains that sooth'd a Mother's shade,
> And grac'd her memory with immortal praise."

The lines were to be inscribed on the pedestal of an urn to be erected in the garden of the Priory, Darwin's last home. The poem is to be found in Poems and Sonnets by the Rev. R.N.French of Foremark, Derbyshire. There is a copy in the Public Library of Derby, but not in the British Museum. (2nd ed. 1813)

(2) Eliza Meteyard. The Life of Josiah Wedgwood. 1865. Vol.II. p.243.

The lines on Brindley in The Economy of Vegetation are perhaps the promised eulogium. He is described as the god-child of the Nymphs of Water, who smiled upon his cradle and nursed him with fairy love. In later years:

"....with strong arm immortal BRINDLEY leads
His long canals, and parts the velvet meads;
Winding in lucid lines, the watery mass
Mines the firm rock, or loads the deep morass,
With rising locks a thousand hills alarms,
Flings o'er a thousand streams its silver arms,
Feeds the long vale, the nodding woodland laves,
And Plenty, Arts, and Commerce freight the waves."[1]

To Darwin the most significant achievements are always those directly related to the needs of men in society. He writes here in a classical tradition, but also as a scientific humanist; and any connection here with the growth of plants, or agriculture is probably quite fortuitous. He does not dwell on it, but passes to the directly elegiac:

"- NYMPHS! who erewhile round BRINDLEY'S early bier
On snow-white bosoms shower'd the incessant tear,
Adorn his tomb! - oh, raise the marble bust,
Proclaim his honours, and protect his dust!
With urns inverted, round the sacred shrine
Their ozier wreaths let weeping Naiads twine;
While on the top MECHANIC GENIUS stands,
Counts the fleet waves, and balances the lands."[2]

A note explains that Brindley "died at Turnhurst in Staffordshire in 1772, and ought to have a monument in the cathedral church at Lichfield."[3]

---

(1) E.V.III. ll.329-36.
(2) E.V. III. 337-44.
(3) E.V.III. l. 321, n.

Mechanic Genius leads Darwin on to an explanation in verse of the action of the pump, illustrated by a description of a child at the breast. This is followed by an exhortation to mothers to nurse their children, inspired, as a note indicates, by "an elegant little poem"[1] on the same subject, entitled Il Latte, by Edward Jerningham. Jerningham, a wealthy dilettante, and a member of Lady Miller's circle at Batheaston, was a correspondent of Anna Seward, so that Darwin may have known something of him personally. At any rate, the compliment is ingeniously introduced.

The action of the pump is further illustrated by an account of an improved fire-extinguisher, explained in a note; and this affords an opportunity for the introduction of a long and lurid description in verse of two London fires, of which Darwin had read in periodical publications.[2]

The subject of vegetable growth has been gradually receding into the background; though some connection with water is preserved throughout the canto. After bringing the fires to a dramatic end, however, Darwin suddenly returns to the main theme. The Nymphs of Water are called upon to guard and cherish the young plants, and a footnote provides

---

(1) E.V.III. 1.367, n. See Poems. By Mr.Jerningham. 1786. p.54.

(2) E.V.III. 11.393-410, and 1.396, n. For the fire at Lady Molesworth's see Gentleman's Magazine. 1763. p.255; and Annual Register, 1763. Chronicle for May 6. (p.75). There is no description of the fire at Mr.Woodmason's. For brief references, see Gentleman's Magazine, 1782, p.151 and p.357.

information on the structure and function of leaves, and on plant irritability and sensitivity.[1] The Nymphs are then, surprisingly, compared to a certain Miss Jones of Ireland, who performs secret acts of charity. They are next exhorted thus:

> "CALL YOUR light legions, tread the swampy heath,
> Pierce with sharp spades the tremulous peat beneath;
> With colters bright the rushy sward bisect,
> And in new veins the gushing rills direct."[2]

They are compared to Hercules, who conquered Achelous, or, according to the interpretation of the fable which Darwin favours, turned the course of one arm of the river which had deluged Etolia, and restored plenty to the land. Drainage is followed by "the practice of flooding lands",[3] the advantages of which Darwin expounds in a footnote. In the verse, the roots of plants, absorbing water from the veins of the earth, are compared, first, to the lacteal system of the animal body, and then, more extravagantly, to a band of pilgrims to Mecca, drinking from an oasis. The Botanic Goddess then dismisses the assembled company.

It can be seen that the matter of this canto is extremely varied. Little of it has any direct connection with the growth of vegetables. Indeed, almost nothing was

---

(1) E.V.III. 1.439, n; and 1.440, n. cf. <u>The Physiology of Plants</u>, p.209. and <u>The Loves of the Plants</u>, p.269 ff below.
(2) E.V.III. 11.463-6. And see 1.475, n.
(3) E.V.III. 11.515-26 and 1.520, n.

known at this time of the part played by water in plant nutrition. It was realised that water was not the only food of plants, and that some mineral substances were necessary to their growth; but although a decomposition of water in plant vessels was suspected, the relation of this to the different vital processes could not, in the contemporary state of chemical knowledge, be satisfactorily explained. There was not, therefore, a great deal to be said about the operation of water as far as it affected the growth of vegetables. Darwin could not go beyond general remarks on the necessity of rain, the harmfulness of frost, and the benefits to be derived from drainage and irrigation. So the canto becomes a repository for everything remotely related to water; and the most readable sections of it are those where the personal, and not the scientific, interest predominates. The scientific sections, such as those on the circulation of water, on glaciers, on the monsoons, though included more legitimately than the compliments and elegies, make harder reading because the verse is overweighted with explanatory notes. The difficulty involved seems insoluble. The notes do not stand independent of the verse and form a coherent whole; nor is the verse completely intelligible without the notes. It is difficult, indeed, to see how scientific instruction on the scale

Darwin visualised could have been successfully combined with poetic entertainment. The Loves of the Plants, where entertainment is the primary object, is infinitely more successful, as a poem, than The Temple of Nature, where the verse is little more than a series of elliptical references, relieved by some decorative passages, to material contained in the notes and in Darwin's prose works. The Economy of Vegetation stands midway between the two. And here there were two obstacles to success. The first was that the subject of the poem, as stated in the Advertisement, was not sufficient for a work of this length. Extraneous material had therefore to be added, and the poem was deprived of unity. Secondly, much of this additional material was scientific, and, to varying degrees, of specialised interest. It therefore had to be explained in some detail; and Darwin, assuming in his readers an intellectual curiosity equal to his own, did not stop short at mere explanation, but added theory, inquiry, hypothesis, conjecture, until the notes became of unmanageable size. All the material in the notes is relevant, if only the reader's interest extends far enough; but as he pursues Darwin's explanations and suggestions to their furthermost ramifications, the verse is lost to sight.

The fourth canto of the poem presents the same difficulties as the third, though to a lesser degree.

For nearly half of it is devoted to an exposition of plant physiology and related matters, so that the Sylphs, representing the element of air, are called upon to perform fewer diverse functions than the Nymphs of Water. The basic difficulty, however, remains. There was little to be said about the part played by air in the growth of vegetables, because the facts of plant nutrition and respiration had not at that time been ascertained. Darwin's account of the Sylphs' activities is therefore necessarily confined to their protection of the plants from cold winds, and their encouragement by warm ones. He does, indeed, put forward a theory to explain the production of oxygen by green plants, but it was a theory based only on personal hypothesis, and was disproved within a few years of the publication of the poem. As a stimulus to interest and inquiry it was valuable; but it was not sufficient to occupy half a canto, and other topics had to be introduced. Some of these were relevant. The theory of winds, for instance, which is delivered in a lengthy Additional Note, has direct bearing upon the subject of plant life. The chemical discoveries of Joseph Priestley, which occupy part of the canto, are linked indirectly to the main theme. But other topics, such as balloon ascents and submarine travel, and a pathetic story of the plague in Holland in the seventeenth century, have only a very remote connection with botany, even in a discursive treatment of the subject; though all are directly connected with the question of the nature and sources of air, which must thus be considered the real theme of the canto.

The opening lines see the Sylphs assembled. The Botanic Goddess then rapidly surveys trade-winds, monsoons, and other winds, which are explained in an Additional Note.[1] The whole verse-paragraph is obscure without close reference to the attached explanation. As poetry it is valueless. As instruction it is vague. Some lines, indeed, are difficult to follow. Thus, we must turn to the Additional Note to find the scientific explanation of the facts that the wind blows in from the sea over tropical islands during the hottest part of the day, and from the islands out to sea in the morning, before we can grasp the meaning of the following:

"YOUR playful trains, on sultry islands born,
Turn on fantastic toe at eve and morn;
With soft susurrant voice alternate sweep
Earth's green pavilions and encircling deep."[2]

The whole subject, however, was undoubtedly of compelling interest to Darwin's scientifically-minded contemporaries. Meteorological study had for many years been actively encouraged by the Royal Society. In 1723

---

(1) E.V. Add.Note XXXIII.
(2) E.V. IV. ll.17-20.

an invitation was issued through the *Philosophical Transactions* to all those interested to send in to the Society annual records of their meteorological observations; and exact instructions were issued as to how these observations were to be made. Thus the *Journal of the Weather* attached to Darwin's Note on winds must be typical of many to be found in the note-books of amateur scientists of the time; although he adds theory and conjecture to mere observation. It illustrates, too, the general desire among scientists of the century, to provide, by way of accurate and controlled observation, a rational explanation of all natural phenomena. Winds were particularly difficult to explain. Observations made at different and widely separated points on the globe's surface had to be correlated; and meteorologists often had to rely simply on the reports of travellers, who might or might not be scientists. The currents of the atmosphere beyond a certain height could only be a matter for conjecture. And although the study of meteorology had been stimulated by the development, in the previous century, of the barometer, thermometer and other instruments, the barometer, as far as the study of winds was concerned, proved a misleading guide, since until the end of the eighteenth century its variation was usually attributed to the agency of winds, and not to the fact that water-vapour is lighter than air. The whole subject was therefore confused; and theories were bound to be tentative. Thus in the late seventeenth century Martin Lister, a scientist of some repute in his own day, had in all seriousness suggested that the trade-winds consisted of the daily exhalations of a certain sea-weed. The theory of winds which Darwin himself put forward has certain affinities with this, although it is expressed in scientific language.

The exposition of this theory, however, is delayed until later in the canto. Having surveyed the winds in brief he turns to the evolution of air by green plants in sunlight, a subject which belongs strictly to plant physiology,[1] but which is also related to the main theme in that the oxygen so produced helps to form winds. He then describes, from various authorities, the sirocco, the simoom, tornado and fog; fog leads, via the "contagious miasmata"[2] arising from morasses, to a poetical account of episode of the plague which swept over Holland in 1636.[3] Then, returning to meteorology, Darwin pays tribute to

---

(1) See above, note 1, p. 50.
(2) E.V. IV. l.82, n.
(3) Darwin's direct source is a Latin poem entitled <u>Pestis Venere Curata</u>, by Vincentius Fabricius. See <u>Miscellanea Curiosa Medico-Physica Academiae Naturae Curiosorum</u>. Annus Secundus. (Dec.I.) Jenae. 1671. Observatio CLXXXVIII. E.V. IV. ll.87-114. follow the Latin closely.

Torricelli, inventor of the barometer, and Boyle, who perfected the air-pump. A further tribute, to Montgolfier and Rosière, pioneers of balloon aviation, leads on to a compliment to Joseph Priestley on his discoveries concerning gases, and to various matters arising out of them.[1] The Sylphs are next addressed as the creators of music and the teachers of Handel. Then, in contrast, they are shown as the instruments of divine justice. The destruction of Sennacherib's army is described as the effect of pestilential winds; and this brings Darwin to the point. He appeals to them to undertake the care of "the green children of the Spring":

> "Ethereal cohorts! Essences of Air!
> Make the green children of the Spring your care!
> Oh, SYLPHS! disclose in this inquiring age
> One GOLDEN SECRET to some favour'd sage;
> Grant the charm'd talisman, the chain, that binds,
> Or guides the changeful pinions of the winds!"[2]

A note explains that

> "The suddenness of the change of the wind from N.E. to S.W. seems to shew that it depends on some minute chemical cause; which if it was discovered might probably, like other chemical causes, be governed by human agency."[3]

There is no further indication in the verse or footnotes of what is meant by this. The whole theory of the subject is reserved for the Additional Note. It was

---

(1) See below, The Ratiocination of Philosophy, 3, Chemistry.
(2) E.V. IV. 11.305-10.
(3) E.V. IV. 1.308, n.

undoubtedly too complicated, and, Darwin may have felt, too conjectural, to be explained in the poem. So, instead of a scientific exposition, we have:

"Castled on ice, beneath the circling Bear,
A vast CAMELION spits and swallows air;
O'er twelve degrees his ribbs gigantic bend,
And many a league his leathern jaws extend;
Half-fish, beneath, his scaly volutes spread,
And vegetable plumage crests his head;
Huge fields of air his wrinkled skin receives,
From panting gills, wide lungs, and waving leaves;
Then with dread throes subsides his bloated form,
His shriek the thunder, and his sigh the storm.
Oft high in heaven the hissing Demon wins
His towering course, upborne on winnowing fins;
Steers with expanded eye and gaping mouth,
His mass enormous to the affrighted South;
Spreads o'er the shuddering Line his shadowy limbs,
And Frost and Famine follow as he swims.-"[1]

This is a strange monster, and it is strangely linked with the name of Richard Kirwan, who, Darwin explains,

"has published a valuable treatise on the temperature of climates, as a step towards investigating the theory of the winds; and has since written some ingenious papers on this subject in the Transactions of the Royal Irish Society."[2]

In verse, Darwin appeals again to the Sylphs:

"SYLPHS! round his cloud-built couch your bands array,
And mould the Monster to your gentle sway;
Charm with soft tones, with tender touches check,
Bend to your golden yoke his willing neck,
With silver curb his yielding teeth restrain,
And give to KIRWAN'S hand the silken rein."[3]

---

(1) E.V. IV. 11.321-36.
(2) E.V. IV. 1.342, n. Kirwan's Estimate of the Temperature of Different Climates was published in 1787. Darwin's theory owes less to this, however, than to the Essay on the Variations of the Barometer, mentioned below.
(3) E.V. IV. 11.337-42.

The Camelion, and its connection with Kirwan, can only be fully understood by a study of the Additional Note entitled Winds. And what Darwin has to say in this note is best considered after some preliminary survey of Kirwan's work.

To the Transactions of the Royal Irish Academy for 1788 Kirwan had contributed a paper entitled Essay on the Variations of the Barometer,[1] in which he explained that these variations may be due to one of several possible causes. They had been ascribed to change of temperature, to accumulation of air owing to confluence of contrary winds, and to the agency of vapours. By this last Kirwan meant the agency of water-vapour, which de Saussure had demonstrated to be lighter than air, and had put forward as the cause of barometric variation. Kirwan, however, rejected all three explanations. He suggested that there is an actual variation in the total mass of air. He explained that hydrogen is produced in great quantities between the tropics, from the putrefaction of animal and vegetable substances and by other natural operations, and that this hydrogen flows out towards the poles, where it is consumed in combustion and produces the aurora borealis and australis. The variations to be observed in barometric pressure are therefore due to varying quantities of hydrogen passing from the tropics to the poles.

(1) The Transactions of the Royal Irish Academy. 1788. Vol. II. Science. p.43.

This theory is evidently the basis of Darwin's statement that

> "The theory of the winds is yet very imperfect, in part perhaps owing to the want of observations sufficiently numerous of the exact times and places where they begin and cease to blow, but chiefly to our yet imperfect knowledge of the means by which great regions of air are either suddenly produced or suddenly destroyed."[1]

He assumes a variation in the quantity of the atmosphere. But he does not restrict himself to an increase and diminution of hydrogen. He explains that oxygen is continually produced in large quantities by green plants in sunlight and by the action of light on water; that nitrogen is continually set at liberty from its combinations in animal and vegetable bodies by putrefaction and combustion; and that both these gases are again removed from the atmosphere by the formation of nitre and oxides, and by combination with the hydrogen of the atmosphere to form water and volatile alkalis. This alternate production and consumption of gases occurs chiefly within the tropics and at the poles, but is carried on to a lesser extent over all parts of the earth.

With the accuracy of the chemical facts involved we are not here concerned. What is important is Darwin's application of recent discoveries concerning the nature and

---

(1) E.V. Add. Note XXXIII. p.79.

properties of gases to the explanation of other natural processes. He represents "this inquiring age" at its boldest. He was a specialist in no one field, apart from medicine, but he was convinced of the relevance of each branch of science to every other branch, and of the importance of research and inquiry in man's struggle to control and improve his environment. Thus an explanation of the chemical causes of winds must eventually lead, in his view, to a chemical method of controlling them.

The Additional Note further provides an explanation of the prevailing winds of this country, on the basis of the theory of a variation in the amount of the atmosphere, and accounts for the fact that although air is produced and destroyed at the poles, winds usually take a diagonal direction. This is due to a diminution in the velocity of the earth's surface, as it moves round its axis, from the equator to the poles. The explanation, which must have been well known by the end of the century, was first put forward by George Hadley, in a paper entitled Concerning the Cause of the General Trade Winds, published in the Philosophical Transactions for 1735.[1] The Note also contains much subsidiary theory, explanation and illustration, includes a Journal of the Weather, and ends thus:

---

(1) Vol. XXXV. p.58. cf. E.V. Add. Note XXXIII. p.81.

> "The writer of this imperfect sketch of anemology wishes it may incite some person of greater leizure and ability to attend to this subject, and by comparing the various meteorological journals and observations already published, to construct a more accurate and methodical treatise on this interesting branch of philosophy."[1]

After studying this lengthy dissertation the reader can understand that the "Camelion", proverbially fed on air, is but a poetic symbol of complicated chemical reactions by which air is produced and destroyed. Darwin explains that since the immediate causes of this variation in the total mass of air cannot yet be ascertained,

> "...we may still suspect that there exists in the arctic and antarctic circles a BEAR or DRAGON yet unknown to philosophers, which at times suddenly drinks up, and as suddenly at other times vomits out one-fifteenth part of the atmosphere: and hope that this or some future age will know how to govern and domesticate a monster which might be rendered of such important service to mankind."[2]

We are presumably to understand that the "leathern jaws", "scaly volutes" and "vegetable plumage" of the monster represent chemical changes brought about in the common atmosphere, in sea-water, and by the agency of plants. The symbolism, however, is very general; the creature is a product of Darwin's visual imagination and sense of humour.

The theory of winds, although deriving to some extent from Kirwan, had evidently been occupying Darwin's mind

---

(1) E.V. Add. Note XXXIII. p.93.
(2) Ibid. p.89.

for some time. In the paper entitled Frigorific Experiments on the Mechanical Expansion of Air, which was read before the Royal Society in December 1787,[1] before the publication of Kirwan's Essay, he puts forward the same suggestion, that it may in future be possible to control the winds, perhaps by the application of chemical knowledge to meteorology. Kirwan's theory of the production and destruction of hydrogen evidently supplied him with a basis on which to construct a complete theory.

It will be evident, from this chapter and from subsequent chapters, that Darwin's theories were more often founded on conjecture than upon scientifically observed fact. He himself was not unaware of this. He disarms the critical reader, and explains his own attitude towards the pursuit of knowledge, in the Apology prefixed to The Economy of Vegetation. He declares:

> "It may be proper here to apologize for many of the subsequent conjectures on some articles of natural philosophy, as not being supported by accurate investigation or conclusive experiments. Extravagant theories however in those parts of philosophy, where our knowledge is yet imperfect, are not without their use; as they encourage the execution of laborious experiments, or the investigation of ingenious deductions, to confirm or refute them. And since natural objects are allied to each other by many affinities, every kind of theoretic distribution of them adds to our knowledge by developing some of their analogies."[2]

---

(1) Philosophical Transactions, Vol.LXXVIII.(1788) p.43.
(2) E.V. Apology. p.[vii].

And he was happy, in that he lived in an age in which every field of science was open to the amateur; when so much had been accomplished, and so much more seemed to be almost within grasp; and when every educated man might hope to contribute to the achievements of the new scientific era. The Economy of Vegetation was written in a spirit of high optimism - it might almost be said, perhaps, that it represents a last flowering of the English Renaissance. For Darwin had taken all knowledge to be his province. And if we accept the spirit in which the work was written, we can accept the inclusion, in a study of the economy of vegetation, of the many and varied scientific topics with which it deals.

THE RATIOCINATION OF PHILOSOPHY

The "Operations of the Elements" have a nominal, if not an actual, relevance to the subject of the growth of vegetables. The reader of The Botanic Garden finds, however, that the poem also contains a complete theory of the origin and history of the earth, an account of the most recent advances in chemistry, an exposition of the science of electricity, and a report of the latest development of industry, the effective harnessing of steam power to machinery. These have no particular connection with plant physiology. They are not essential, one would think, to a poem on botany. They represent, however, Darwin's wider purpose, stated in the Advertisement to The Economy of Vegetation.

> "The general design of the following sheets is to inlist Imagination under the banner of Science; and to lead her votaries from the looser analogies, which dress out the imagery of poetry, to the stricter, ones which form the ratiocination of philosophy".[1]

These are Darwin's words. He is concerned with "philosophy", or science, as a whole. His original theme, the Linnaean system of botany and the physiology and growth of plants, has expanded to include the natural world in which the plants exist, man's knowledge of this world, and the application of his knowledge to the improvement of his own environment and state. The extension is natural and logical, and Darwin was fortunate in

(1) E.V. Advertisement. p.[v].

that he lived in an age when it was possible, when one man could survey and understand the whole field of natural philosophy, and could hope to communicate his knowledge to the general reader. Whether a poem was the most suitable means of communication is another matter. But the fact remains that the subject of The Economy of Vegetation is the science of Darwin's period, and if we are to appreciate the poem to the full, we must follow his excursions into the facts and theories of its various branches. This chapter will therefore contain some attempt to elucidate his treatment of the different topics mentioned above, to indicate his opinions and some of their sources, to show how he adapted, modified or elaborated existing theories, and to demonstrate that much of the material of his poetry developed out of his personal contacts with leading scientists of his day, as well as out of his wide reading and extensive interests. The different subjects will be treated under the separate headings of Cosmogony, Geology, Chemistry, the Steam-Engine, and Electricity, in that order.

(1) Cosmogony

The first canto of the poem is devoted to the element of Fire, and the first subject treated, after the scene has been laid and the Rosicrucian machinery set in motion, is the evolution of the stellar system out of the primeval chaos.

The second canto, which deals with the element of Earth, treats more particularly of the early history of the world and of its development into its present form. Darwin's presentation of these subjects, however, is no mere recapitulation of conventional theory. He is acquainted with the work of the most advanced thinkers of his day, as well as with the opinions of the conservative, and he has applied his own powers of speculation to the most problematical parts of the subject. The result is a bold hypothesis, a theory which surpasses every other in freedom of conjecture, and which could hardly fail to awaken, in the most indifferent reader, an interest in "the ratiocination of philosophy".

The force which produced the cosmos, Darwin explains, was heat:

"NYMPHS OF PRIMEVAL FIRE! YOUR vestal train
Hung with gold-tresses o'er the vast inane,
Pierced with your silver shafts the throne of Night,
And charm'd young Nature's opening eyes with light;
When LOVE DIVINE, with brooding wings unfurl'd,
Call'd from the rude abyss the living world.
' - LET THERE BE LIGHT!' proclaim'd the ALMIGHTY LORD,
Astonish'd Chaos heard the potent word; -
Through all his realms the kindling Ether runs,
And the mass starts into a million suns;
Earths round each sun with quick explosions burst,
And second planets issue from the first;
Bend, as they journey with projectile force,
In bright ellipses their reluctant course;
Orbs wheel in orbs, round centres centres roll,
And form, self-balanced, one revolving Whole.
- Onward they move amid their bright abode,
Space without bound, THE BOSOM OF THEIR GOD!"[1]

(1) E.V. I. ll. 97-114.

This account has something in common with Milton's description of the Creation,[1] by which it was perhaps to some extent inspired. There are a few echoes of phrase, as the "brooding wings" and the adjective "self-balanced",[2] which suggest that Darwin may have recalled, consciously or unconsciously, the words of Paradise Lost. In outlook, however, Milton and Darwin are separated by more than simply a space of years. Milton, like Darwin, was at home in the scientific world of his own day; he was familiar with the Copernican system; and his use of the traditional cosmology is undoubtedly symbolical. But the symbolism is nevertheless directed and coloured by Milton's religious attitude. He was primarily concerned with the religious significance of his theme, and though he was aware of modern science, he subdued his knowledge of it to his religious and poetic purposes. With Darwin it is different. To him, science comes before religion, and though he uses a symbolism derived from the Bible, he is more concerned with its aesthetic and emotional than with its religious associations. He may even regard it as a respectable cloak for unorthodox ideas, for by the time he came to write science and orthodox religious belief were becoming irreconcilable in a way hardly realised in the previous century.

(1) Paradise Lost. Bk.VII. ll.216-260. The Poetical Works of John Milton. ed. H.C. Beeching, Oxford. 1941. p.323.
(2) E.V. I. l.101 and l.112. cf. Milton, op.cit., l.235 and l.242.

The fact that Darwin can use the phrase "vestal train",[1] with its classical and pagan associations, in this context, perhaps suggests something of his attitude. The use of "self-balanced", too, indicates the gulf between Milton and Darwin. To the poet-scientist of the eighteenth century the word implies a mathematical theory of universal gravitational attraction It is an indirect tribute to the work of Newton. The "self-ballanc't" of Milton not only belongs to an earlier, and even at that time almost discredited cosmology, but carries for Milton, and for his readers, associations that are chiefly theological. The whole emphasis is different. And though Darwin's verse may reflect the influence of Milton, his thought owes more to the work of the French scientist Buffon. It is perhaps relevant here that Buffon's Epoques de la Nature[2] opens with an examination of the first verses of the Book of Genesis which forms an introduction to a theory of the evolution of the earth which, in its day, was in complete contradiction to orthodox teaching in both France and England. Buffon covers his lack of orthodoxy by an apparent reconciliation of reason and revelation. Darwin speaks in a similar tone when he explains that if the universe was created in the manner he describes, "a grander idea cannot be conceived by the mind of man",[3] and when he describes this creation

(1) E.V.I. l.97.
(2) 1778. Oeuvres Complètes de Buffon. Paris 1878. Vol.I.p.388.
(3) E.V.I. l.105. n.

as the work of "LOVE DIVINE".[1] A footnote attached to this last phrase, which touches on the evidence for organic evolution, further suggests the influence of Buffon, since it was from Buffon that Darwin derived his theory of evolution.

Buffon thus appears to exercise a general influence on Darwin's thought. More immediate sources of this part of The Economy of Vegetation, however, are Lavoisier's theory of heat,[2] and the work of the astronomer Herschel.

Lavoisier had explained that caloric, or the matter of heat, of which light might be regarded as a manifestation, was a repulsive and expansive power, existing between the particles of all bodies in varying quantities. This is the theory behind Darwin's explanation that the original chaotic mass was exploded by a sudden infusion of heat, giving rise to suns and their planets. The words "LET THERE BE LIGHT",[3] therefore, symbolise, in Darwin's verse, a physical phenomenon. His "PRIMEVAL FIRE" and "kindling Ether"[4] have, of course, much in common with Milton's "vital warmth" and "Light ethereal",[5] although Darwin's phrases have a more direct and studied connection with contemporary scientific theory. As far as this he is on common ground with the most orthodox, for as late as 1790 the Swiss scientist de Luc, in an

(1) E.V.I. l.101.
(2) A.L.Lavoisier. Elements of Chemistry. Translated by Robert Kerr. 1790. pp.1-26.
(3) E.V.I. l.103.
(4) E.V.I. l.97 and l.105.
(5) Milton, op.cit., l.236 and l.243.

article in the Monthly Review,[1] of which Darwin makes use elsewhere, declares that it was the actual addition of light, the chief component of "fire" or heat, to the confused mass of chaos, which effected the creation of the world. And de Luc was strictly orthodox. Darwin's authority for the extension of this theory to cover the creation of the whole universe is taken from the papers contributed by Sir William Herschel to the Philosophical Transactions. In a series of papers dating from 1783,[2] Herschel had shown that the sun and the other stars are in motion relative to each other, that the Milky Way is nothing but a stratum of stars, and that the sun belongs to this stratum, and that the whole of our sidereal system is in motion around a common centre of gravity. He had also made a special study of nebulae. He at first thought of these as clusters of stars at an immense distance from our system, but later came to the conclusion that they had originally been vast masses of phosphorescent vapour, which were gradually condensing into clusters of solid bodies or stars. Mutual attraction had drawn them into clusters. Darwin had read and absorbed all this. He explains that Herschel

---

(1) J.A.de Luc. First Letter to Dr James Hutton. Monthly Review. June 1790. Art.XV. p.216.
(2) See On the proper Motion of the Sun and Solar System. Philosophical Transactions, LXXIII (1783). p.247. Account of some Observations tending to investigate the Construction of the Heavens. Ibid., LXXIV (1784). p.437. On the Construction of the Heavens. Ibid., LXXV. (1785) p.213.

> "observes that in the vicinity of these clusters of stars there are proportionately fewer stars than in other parts of the heavens; and hence he concludes that they have attracted each other, on the supposition that infinite space was at first equally sprinkled with them; as if it had at the beginning been filled with a fluid mass, which had coagulated. Mr.Herschel has further shewn, that the whole sidereal system is gradually moving round some centre, which may be an opake mass of matter. Philos. Trans. V.LXXIV."[1]

Then, ignoring the coagulation of the original fluid, and concentrating on the central opaque body, he continues,

> "If all these Suns are moving round some great central body; they must have had a projectile force, as well as a centripetal one; and may thence be supposed to have emerged or been projected from the material, where they were produced. We can have no idea of a natural power, which could project a Sun out of Chaos, except by comparing it to the explosions or earthquakes owing to the sudden evolution of aqueous or of other more elastic vapours; of the power of which under immeasurable degrees of heat, and compression, we are yet ignorant."[2]

Darwin has thus assimilated Herschel's conception of the evolution of the cosmos according to physical laws, but he rejects the theory of a gradual coagulation for one of a sudden explosion. His insistence on the expansive powers of superheated and compressed vapours no doubt derives from his acquaintance with James Watt, and his knowledge of the principles upon which Watt's steam-engine was constructed. Remembering the laws of gravitation, however, he notes that the suns should, after the explosion, have returned to the

---

(1) E.V.I. 1.105.n. (Darwin's reference is more specifically to the papers in Vols.LXXIII and LXXV of the <u>Philosophical Transactions</u>. See note 2, p.76 above).
(2) Ibid.

mass whence they were projected; and to surmount this difficulty he has to assume that the whole of Chaos was exploded at once,[1] conveniently forgetting the opaque central body round which the suns are circling, and which, as he points out in an Additional Note, corresponds with "the very antient and general idea of a chaos."[2] This confusion is perhaps a natural result of eclecticism. Nevertheless, phrases like "projectile force", "bright ellipses", "reluctant course", and the lines

> "Orbs wheel in orbs, round centres centres roll,
> And form, self-balanced, one revolving Whole."[3]

with their suggestion of a neat summing up of the Newtonian system in the pithy style of Pope, are poetically, if not scientifically, convincing. The whole theory was a daring conjecture, springing from the most advanced scientific investigations of the day, but lacking any real scientific support.

In the second canto of the poem Darwin sets out his theory of the origin of the earth in more elaborate detail. He explains that

> "From the deep craters of his realms of fire,
> The whirling Sun this ponderous planet hurl'd,
> And gave the astonish'd void another world".[4]

---

(1) Ibid.
(2) E.V.Add.Note. XV. p.29.
(3) E.V.I. ll.111-12.
(4) E.V.II. ll.14-16.

It is not made altogether clear, either in the footnotes or in the Additional Note[1] which deals with the subject, whether Darwin finally decided when this took place. It may have been, as he originally suggested, when Chaos was exploded; or, as these lines imply, at some later date. What is clear is that the main idea was derived from the work of Buffon. In his Théorie de la Terre, published in 1749, Buffon had stated that the planets of our system originally formed part of the sun, and were detached from it by the impact of a large comet. Darwin mentions this theory in his Additional Note, but is not altogether satisfied with it. He observes that a comet is only a planet with a more eccentric orbit, and must therefore have also had its origin in the sun. Nor does Buffon's theory account for the orbits of the satellites. The planets were therefore detached from the sun by some other agency.

In 1769 Professor Alexander Wilson, of Glasgow, had carried out a systematic observation of sunspots. In a paper communicated to the Royal Society in 1774[2] he expressed his conviction that the sunspots were cavities on the surface of the sun. He made several suggestions concerning their appearance and disappearance, but committed himself to no

---

(1) E.V.Add.Note XV. and cf. Add.Note XXIV. Geological Recapitulation.1. p.65.
(2) Alexander Wilson. Observations on the Solar Spots. Philosophical Transactions LXIV (1774). p.1.

one theory. Darwin, who was interested in the subject of earthquakes and volcanoes, at that time regarded as different manifestations of the same phenomenon, and had read a paper on earthquakes written by his friend John Michell, and published in the Philosophical Transactions for 1760[1], was led to connect earthquakes with sunspots by reason of the fact that Herschel had recently demonstrated the existence of volcanic craters on the surface of the moon. Arguing by analogy, Darwin explains that sunspots are volcanic craters on the sun, from which the planets and comets have been ejected. The long Additional Note[2] provides proof, based on the laws of mechanics, of this theory of the origin of the planets, including the earth. A quotation from a letter written to him in 1787 by his friend William Ludlam, a clergyman of Leicester, shows that the whole question had been the subject of discussion and correspondence at some length.

The nucleus of the earth was thus thrown out from the sun in a semi-fluid state, and was surrounded by hot vapour, which, as it cooled, condensed and formed an ocean completely surrounding the earth. The earth, from the attraction of its own parts, had by this time assumed a spherical shape.[3] In the newly formed ocean life began:

---

(1) John Michell. Conjectures concerning the Cause, and Observations upon the Phaenomena of Earthquakes; Philosophical Transactions LI. Part II. (1760) p.566.
(2) E.V.Add.Note XV.
(3) E.V.II. 1.17.n.

"The nucleus of the earth, still covered with water, received perpetual increase by the immense quantities of shells and coralloids either annually produced and relinquished, or left after the death of the animals. These would gradually by their different degrees of cohesion be some of them more and others less removable by the influence of ~~the~~ solar tides, and gentle tropical breezes, which then must have probably extended from one pole to the other; for it is supposed the moon was not yet produced, and that no storms or unequal winds had yet existence".[1]

All strata of rocks above the original solar nucleus of the earth were, according to Darwin, of organic origin. The first land to appear above the surface of the ocean consisted of the remains of sea-animals, and took the form of "primeval islands", raised only a few feet above the level of the water. Addressing the Gnomes, Darwin explains:

"YOU trod with printless step Earth's tender globe,
While Ocean wrap'd it in his azure robe;
Beneath his waves her hardening strata spread,
Raised her PRIMEVAL ISLANDS from his bed,
Stretch'd her wide lawns, and sunk her winding dells,
And deck'd her shores with coral, pearls, and shells".[2]

Capability Brown springs to mind; but that may have been Darwin's intention. The Primeval Islands are derived directly from the work of Darwin's friend John Whitehurst, "Who was many years a watch-maker and engineer at Derby, but whose ingenuity, integrity, and humanity, were rarely equalled in any station of life".[3] Whitehurst had died in 1788. He had for many years made the study of geology the main pursuit of his leisure, and in 1778 had published <u>An</u>

(1) E.V.II. l.36.n.
(2) E.V.II. ll.33-38.
(3) E.V.II. l. 17.n.

Inquiry into the Original State and Formation of the Earth, of which a second edition was issued in 1786. In this work he expounded a theory of the separation, by chemical affinity, of an original chaotic mass of heterogeneous components into air, water and earth, to form the world as it existed before the Flood. He was genuinely anxious to reconcile reason and revelation, and explained that God could have created the world instantaneously, but since nature works according to constant laws,

> "by whatever mode the operations of Nature are continually carried on, we may thence conclude, that by the same mode the chaos was formed into a habitable world".[1]

Thus, out of the original chaos, a solid nucleus of earth was formed, covered by water, and surrounded by the atmosphere. At the bottom of the ocean were deposits of solid, but loose material, which were shifted about by the action of lunar tides until they became irregularly accumulated, and patches of solid earth appeared above the surface of the water. These formed "primitive islands", which in time became firm, and fit for animal and vegetable life.

Marine animals were first created; terrestrial animals followed; and finally, the primitive islands were inhabited

---

(1) John Whitehurst. An Inquiry into the Original State and Formation of the Earth. 1778. (2nd ed. 1786. p.28).

by the human species. Since extremes of heat and cold result from quantity of land, the climate was temperate. Vegetation flourished, and sufficed for the needs of humanity without art or labour. Property and its consequent evils were unknown, and Paradise, or the Golden Age, had a real existence. This idyllic picture is the source of Darwin's description of the Primeval Islands:

> "O'er those blest isles no ice-crown'd mountains tower'd,
> No lightnings darted, and no tempests lower'd;
> . . . .
> Round the bright zodiac danced the vernal hours,
> And Peace, the Cherub, dwelt in mortal bowers!"[1]

A discussion of rainbows, contained in a footnote, together with an explanation of the original freshness of the ocean, is also suggested by Whitehurst's book.[2] Darwin differs from Whitehurst in his theory that the islands consisted of the remains of marine organisms, and in his attribution of their formation to solar tides. For the moon did not then exist, according to his system. It is not clear whether his reference to "mortal bowers" really implies that human life existed on the islands, although he echoes Whitehurst in saying that "the paradise of the sacred writers, and the golden age of the prophane ones, seems to have had a real existence."[3] For he believed in

---

(1) E.V.II. ll.39-40 and ll.45-46.
(2) E.V.II. 1.36.n. (cf. Whitehurst, op.cit., p.173.)
(3) Ibid.

a gradual evolution of organic forms, culminating in man, and taking place over long ages of time.[1] The primeval islands would therefore persist until comparatively recently in the earth's history.

The Golden Age, however, if it existed, did not last. Whitehurst had explained that in the course of time fire was generated within the earth, came into contact with water, and produced steam, whose expansive power disrupted the strata, destroyed the primitive islands, and produced the continents and mountains that we know. The submergence of the primitive islands was the Flood of Biblical tradition; fossil-shells on mountain-tops could be accounted for by the fact that these mountsins had before the Flood formed part of the floor of the ocean; and reason and revelation were reconciled. Darwin finds much in this that he can use, although he modifies and elaborates Whitehurst's theory.

Whitehurst had derived his idea of the expansive force of heated water-vapour as the immediate cause of the first and greatest earthquake from John Michell's paper on earthquakes, published in the Philosophical Transactions for 1760.[2] This paper was the first work on the subject in which earthquakes were treated from the modern point of view as the

---

(1) See below, <u>The Production of Life.</u>
(2) See Whitehurst, op.cit., p.127.

result of a shock that sends waves through the crust of the earth, though Michell had assumed that the steam which caused the shock actually travelled beneath the earth. He had pointed out, however, that although subterranean fires must be supposed to exist, it was difficult to see how they could do so without the presence of air in the centre of the earth. Darwin is able to dispose of this difficulty. He refers his readers to Michell's treatise, and explains that

> "the difficulty of understanding how subterraneous fires could exist without the presence of air has disappeared since Dr.Priestley's discoveries of such great quantities of pure air which constitute all the acids, and consequently exist in all saline bodies, as sea-salt, nitre, lime-stone, and in all calciform ores, as manganese, calamy, ochre, and other mineral substances."[1]

Furthermore, not only would steam be produced from the contact of fire with the ocean, as the crust of the earth cracked as a result of expansion due to heat, when the first subterraneous fires began, but the heat would also decompose the steam and

> "produce inflammable air and vital air in quantities beyond conception, sufficient to effect those violent explosions, the vestiges of which all over the world would excite our admiration and our study."[2]

This, if not sound chemical theory, at least shows that Darwin was anxious to apply new chemical knowledge to the solution of problems belonging to other sciences.

---

(1) E.V.II. l.68, n.
(2) Ibid.

The first earthquake thus occurred. Its most remarkable feature is also the most startling and original part of Darwin's theory:

> "GNOMES! how you shriek'd! when through the troubled air
> Roar'd the fierce din of elemental war;
> When rose the continents, and sunk the main,
> And Earth's huge sphere exploding burst in twain.-
> GNOMES! how you gazed! when from her wounded side
> Where now the South-Sea heaves its waste of tide,
> Rose on swift wheels the MOON's refulgent car,
> Circling the solar orb, a sister-star,
> Dimpled with vales, with shining hills emboss'd,
> And roll'd round Earth her airless realms of frost."[1]

There is no development of this idea, or reference to its sources, in the notes. Darwin restricts himself to a discussion of the moon's atmosphere;[2] and this unusual reticence suggests that this hypothetical event was purely of his own invention. He explains in some detail, however, the effect on the earth of the ejection of the moon. Its axis would be turned out of its previous direction, and the shock would overturn "all its buildings and forests."[3] The primeval islands were therefore presumably occupied by civilised human beings. Further,

> "... islands and continents were raised, consisting of granite or lava in some parts, and of limestone in others; and great vallies were sunk, into which the ocean retired".[4]

---

(1) E.V.II. 11.73-82.
(2) E.V.II. 1.82,n. He had evidently discussed his theory of the origin of the moon with his friend William Ludlam. See E.V.Add.Note XV. p.31.
(3) E.V.II. 1. 84,n.
(4) E.V.Add.Note XXIV. Geological Recapitulation. 5. p.65.

Darwin hastens to assure his readers that "these first tremendous ignitions of the globe" were incomparably greater than those of modern days, and quotes de Luc's article in the Monthly Review for 1790 on modern earthquakes.[1] It is doubtful whether de Luc can have been pleased to find his name attached to a theory so unorthodox. It can be seen, however, that Darwin's theory of the earth is a "catastrophic" theory similar to those advanced by earlier writers on the subject, such as Thomas Burnet.[2] He has incorporated the theories of Buffon, the discoveries of Herschel, and miscellaneous scientific knowledge and speculation of the time, into these earlier theories. The result is highly original, but it is also unscientific. In many ways Darwin is nearer to Burnet than he is to his friend James Hutton,[3] the founder of modern geology, who refused to concern himself with origins and restricted himself to conclusions drawn from observation and known scientific laws. Darwin, the poet of science, did not possess the qualities of the true scientific investigator. He was content to accept facts and deductions provided by others as the basis, not of investigation, but of conjecture.

---

(1) E.V.II. 1.68. n.
(2) Thomas Burnet. The Sacred Theory of the Earth. 1684.
(3) Darwin makes extensive use, in his geological theory, of Hutton's Theory of the Earth, published in 1785. The two men were on very friendly terms, as is shown by a letter from Hutton to Darwin, evidently one of a number, preserved at Down House.

(2) Geology.

Having explained the origin of the earth, Darwin sets out to describe the formation of the different strata of its surface. The verse description is quite brief. It consists of a series of references, more or less elliptical, to material contained in the accompanying mass of footnotes and Additional Notes, rather than of an organised exposition of the theory, which is both strikingly original and very advanced for its day.

The geology of the time was a very young science. The very word was not used before 1778, when it was introduced by the Swiss scientist de Luc. The limits of the subject had hardly been defined, and it was confused on the one hand with mineralogy, and on the other with cosmogony. Progress was impeded, moreover, by the adherence of many scientists to the so-called Mosaic account of the creation of the world, and James Hutton, who declared that our present continents had once been at the bottom of the ocean, that they were now being eroded by wind and water, forming sediments at the bottom of the ocean which would in due course give rise to new continents - a continuous process, in which "we find no vestige of a beginning - no prospect of an end"[1] was bitterly attacked by the orthodox. Nor had chemical knowledge

(1) Hutton, Theory of the Earth. 1785. p.96.

at that time advanced to the stage at which it could help geologists. Only about fifteen chemical elements were known, and these did not include calcium, silicon and aluminium, the basic constituents of chalk, sand and clay, nor sodium, whose chloride is the main constituent of marine salt. Hutton was unable to convince the "Neptunists", who held that the rocks of the earth's crust had been deposited as precipitates from the original ocean, that their theory was chemically untenable. His own view, that the chief factor in the consolidation of the rocks had been heat, which became known as the "Vulcanist" theory, did not prevail until the third decade of the following century. His Theory of the Earth was published in 1785, and Darwin quotes from it extensively. He draws, indeed, upon a wide variety of geological writings, selecting, combining, synthesising material from diverse sources; and the theory which results probably surpasses every other in boldness of conjecture and range of hypothesis.

The main difference between his theory and those of even the most advanced thinkers of his day, is that whereas the general opinion was that the earth had acquired more or less its present configuration before the creation of life, Darwin placed the beginnings of life in the primitive ocean, before the formation of nearly all the common minerals. Granite, and various related rocks, he considers original solar material. Clay, sand, flint, limestone, coal, iron and some other metals he believes to consist of the remains of living organisms. Limestone and coal were already recognised by advanced geologists to be of organic origin; but Darwin goes astray when he attempts to reduce geology to a single principle and to attribute the formation of all rocks to one cause.

The immediate source of this theory was probably Buffon's Natural History, the major part of which was published between 1749 and 1788. Buffon had aroused antagonism and suspicion in orthodox circles when he stated that marine animals had existed for long ages before the emergence of the higher animals and man, that the remains of these marine organisms had produced all the calcareous rocks of the earth's surface, and that calcareous earth was formed by these primitive animals from water, in the course of their vital processes.[1] Although the most vigorous condemnation of these statements was naturally voiced in France, Buffon had no lack of opponents in Great Britain. Hutton accepted the theory; but the Irish scientist Richard Kirwan, whose work in various fields was admired by Darwin, was most anxious to refute "the unfounded supposition, that shell fish or any animals

---

(1) Buffon. Introduction à l'Histoire des Minéraux. Oeuvres Complètes. 1878. Vol.I. pp.529-30.

possess the power of producing any simple earth",[1] and he attacked Hutton for upholding it. De Luc, at that time librarian to Queen Charlotte, also attacked Hutton. Darwin was therefore discreet. He attributed the theory that the earth was originally covered with water, and for many ages peopled with marine organisms, which in course of time produced the calcareous rocks, to "some philosophers".[2] His main proposition is nevertheless pure Buffon, though carefully expressed:

> "From contemplating the immense strata of lime-stone, both in respect to their extent and thickness, formed from these shells of animals, philosophers have been led to conclude that much of the water of the sea has been converted into calcareous earth by passing through their organs of digestion. The formation of calcareous earth seems more particularly to be an animal process as the formation of clay belongs to the vegetable economy;..."[3]

He explains the formation of calcareous rocks of different types from accumulations of shells as being due to the dissolution of the softer layers into a liquid which filled up the interstices of the harder layers beneath. This process was due, beneath the sea to the water, and after the elevation of the calcareous strata above the sea, to the action of air and dews. Buffon describes it as a filling up of the pores of the lower material by a distillation of a liquid, "un suc pétrifiant",[4] from above. He also explains

(1) Richard Kirwan. Geological Essays. 1799. p.13.
(2) E.V. Add.Note XVI. p.32.
(3) Ibid.
(4) Buffon. De la Pierre Calcaire. Oeuvres Complètes, 1878. Vol.II. p.70.

how spars are formed in limestone, and Darwin repeats his explanation, adding an observation made by Sir Isaac Newton on the double refraction of spars. He adopts Buffon's definition, too, of the difference between marble, limestone and chalk.

In the verse, the Gnomes preside over the formation of calcareous rocks:

> "GNOMES! YOU then bade dissolving SHELLS distil
> From the loose summits of each shatter'd hill,
> To each fine pore and dark interstice flow,
> And fill with liquid chalk the mass below.
> Whence sparry forms in dusky caverns gleam
> With borrow'd light, and twice refract the beam;
> While in white beds congealing rocks beneath
> Court the nice chissel, and desire to breathe.-"[1]

There follows a verse description of the Hercules of Glyco, the Venus de Medici, and other famous statues of marble, the crystalline form of limestone; and the opportunity is taken for a tribute to two contemporary sculptors:

> "Hence on ROUBILIAC'S tomb shall Fame sublime
> Wave her triumphant wings, and conquer Time;
> Long with soft touch shall DAMER'S chissel charm,
> With grace delight us, and with beauty warm;
> FOSTER'S fine form shall hearts unborn engage,
> and MELBOURN'S smile enchant another age."[2]

Darwin explains that the allusions are to Roubiliac's monument to General Wade, in Westminster Abbey, on which Time and Fame contend for the trophy of the General, and to statues of Lady Elizabeth Foster and Lady Melbourn executed by Mrs Damer. His attention may have been drawn to Roubiliac by his

(1) E.V.II. ll.93-100.
(2) E.V.II. ll.109-114.

friend Josiah Wedgwood, who had a great admiration for that sculptor's works in Westminster Abbey. Roubiliac died in 1762, and it is unlikely that Wedgwood knew him personally, but in 1767 he called on his widow, who presented him with her husband's book of designs; and some of the sketches were used in the ornamentation of Wedgwood's cream-ware. Anne Seymour Damer was a sculptress of aristocratic birth, who moved in the fashionable world, and was a friend of both the Duchess of Devonshire and of Mrs Emma Crewe, who had provided the frontis-piece for The Loves of the Plants, ~~poem~~. The works of both Roubiliac and Mrs Damer were much admired at the time, so that Darwin's reference, though it may have arisen in the first place out of personal interest, is highly topical, and designed to appeal to fashionable taste. This citation of the topical and the particular, furthermore, stresses the relevance of scientific study both to the arts in general, and to the ordinary life of the contemporary world. It is not as out of place as it may seem at first sight in a geological dissertation.

From the formation of calcareous earth Darwin turns to the production of sea-salt. He assumes that the water of the original ocean was fresh. When, however, dry land, consisting of granite and calcareous earth, was elevated above the ocean by primeval earthquakes, vegetable life evolved upon it, and eventually the land was covered by forests. In time these decayed and formed morasses. As water passed through the morasses, it washed away various vegetable salts which, together with the salts from animal recrements, were carried into the sea. This became a continuous process, as new forests grew up and new morasses were formed, and to the present day salts are thus conveyed to the sea "where all of them seem to decompose each other except the marine salt."[1] It must be remembered that the chemical composition of marine salt was not known at this date. And the idea that the sea had originally been fresh, but was becoming gradually more salt, was fairly widely accepted at the time.

Having explained where sea-salt comes from, Darwin continues;

"HENCE with diffusive SALT old Ocean steeps
His emerald shallows, and his sapphire deeps.
Oft in wide lakes, around their warmer brim
In hollow pyramids the crystals swim;
Or, fused by earth-born fires, in cubic blocks
Shoot their white forms, and harden into rocks."[2]

A note explains that

"During the evaporation of the lakes of salt-water, as in artificial salt-works, the salt begins to crystallize near the edges where the water is shallowest, forming hollow inverted pyramids; which, when they become of a certain size, subside by their gravity; if urged by a stronger fire the salt fuses or forms large cubes; whence the salt shaped in hollow pyramids, called flake-salt, is better tasted and preserves flesh better than the basket or powder salt; because it is made by less heat and thence contains more of the marine acid."[3]

(1) E.V.Add. Note XVII. p.35.
(2) E.V.II. ll.119-124.
(3) E.V.II. l.119, n.

Darwin refers the reader to The Art of Making Common Salt, by William Brownrigg, which had been published in 1748, and from which the substance of this note was derived. It should be noticed that the word "shoot", which in Darwin's verse might be regarded as an example of his poetic diction, is actually the technical term used of the formation of crystals. He notes that according to Dr.Hutton's theory, the deposition of large natural masses of rock salt was produced by the evaporation of sea-water by subterraneous fires occurring in the early ages of the world, and goes on to a verse and prose description of the famous salt-mines of Wieliczka, near Cracow, about which an eighteenth century legend had grown up. The substance of this legend is according to his account:

> "There is a town in the immense salt-mines of Cracow in Poland, with a market place, a river, a church, and a famous statue, (here supposed to be of Lot's wife) by the moist or dry appearance of which the subterranean inhabitants are said to know when the weather is fair above ground. The galleries in these mines are so numerous and so intricate, that ~~the~~ workmen have frequently lost their way, their lights having been burnt out, and have perished before they could be found. Essais, &c. par M. Macquart."[1]

The Essais ou Recueil de Mémoires sur Plusieurs Points de Minéralogie was published in 1789. In this work Macquart attempts to correct the wide-spread popular conception of the mines; and his account is based on personal observation. He points out that the report that a stream of fresh water

(1) Ibid.

runs through the salt without dissolving it is incorrect. There is a fresh water stream, but it runs through a bed of clay. The "houses" of the underground city are merely cavities cut in the salt, in which the workmen keep their tools. Furthermore, it is long since any workman was lost in the mines, since measures have been taken to avoid this calamity. Thus most of the legend is destroyed. There is, however, a chapel, in size about thirty feet by twenty-four, which is carved entirely out of salt; and there are two smaller chapels, in which a service is held once a year, and a statue, in salt, of Sigismund, a former king of Poland. He says, too;

> "La plus grande partie des galeries de ces mines est si belle, qu'elle ressemble veritablement à des rues tirées au cordeau, et j'en ai vu quelques-unes percées dans un bloc de sel plus pur, refléchissant avec autant de vivacité que de brillant la lumière des flambeaux qu'on y porte pour se conduire."[1]

Darwin's account, therefore, though it derives some details from Macquart, is based on the popular legend which Macquart was trying to destroy, rather than on accurate report. The legend, however, is more effective, poetically, than the truth:

> "Thus, cavern'd round in CRACOW'S mighty mines,
> With crystal walls a gorgeous city shines;
> Scoop'd in the briny rock long streets extend
> Their hoary course, and glittering domes ascend;
> Down the bright steeps, emerging into day,
> Impetuous fountains burst their headlong way,
> O'er milk-white vales in ivory channels spread
> And wondering seek their subterraneous bed.

---

(1) L.C.H.Macquart. Essais ou Recueil de Mémoires sur Plusieurs Points de Minéralogie. 1789. p.50.

Form'd in pellucid salt with chissel nice,
The pale lamp glimmering through the sculptured ice,
With wild reverted eyes fair LOTTA stands,
And spreads to Heaven, in vain, her glassy hands;
Cold dews condense upon her pearly breast,
And the big tear rolls lucid down her vest.
Far gleaming o'er the town transparent fanes
Rear their white towers, and wave their golden vanes;
Long lines of lustres pour their trembling rays,
And the bright vault returns the mingled blaze."[1]

What is particularly interesting about this passage is that it was originally placed, as it stands except for a slight alteration of the first line, in the first edition of The Loves of the Plants. It followed the description, in the fourth canto of this poem, of the subterranean dwelling of Truffelia,[2] and was accompanied by the prose description of the salt mines, and the reference to Macquart, which were later transferred to The Economy of Vegetation. Brownrigg was not mentioned in this context, since an account of the formation of rock salt was not here part of Darwin's purpose. The scientific inaccuracy of his description was therefore not important. When the second edition of The Loves of the Plants was published in 1790, however, the description of the Polish salt-mines and of Lotta had been removed from the poem altogether. But Ocyma, a salt-producing plant, had been added to the fourth canto, accompanied by a description of the metamorphosis of Lot's wife into a pillar of salt, as she looked back upon the ruins of Gomorrah. This was retained in

---

(1) E.V.II. ll.125-142.
(2) The Loves of the Plants. 1789. IV. 1.309.

the third edition,[1] and the original Lotta, together with the salt-mines, was transferred to the first edition of The Economy of Vegetation, where it had a literary, if not a scientific relevance to Darwin's explanation of the formation of rock salt. The fact that he could thus deliberately transfer to a scientific context a passage which had been primarily intended as a poetical ornament drawn from a subject of topical interest, suggests that "the looser analogies, which dress out the imagery of poetry", were more important to him than "the stricter ones which form the ratiocination of philosophy". Or, again, he may have been using a subject of topical interest to awaken interest in related scientific fact.

Salt is followed by nitre, and the formation of nitre-beds is described from an account given in Rozier's Journal de Physique for 1790, which, like Macquart's Essais, was a very recent publication.[2] Then comes a chemical interlude, after which Darwin passes on to the formation of iron, which, like marine salt, he believes to be produced in morasses. A belief in the organic origin of iron was not unheard of at

---

(1) E.V.IV. ll.221-82. On receiving a copy of the 1790 edition of the poem, Anna Seward wrote to Darwin,

"We find the Ocyma a great poetic acquisition; the description it introduces of Lot's wife is much improved, and its interest much heightened from the passage where we found her statue in the saline city, amidst the mines of Poland. People would be apt to wonder 'how the d-l it got there'." Letters of Anna Seward.1811.Vol.II.p.369.

(2) E.V.II.l.143,n. See Rozier. Observations sur la Physique, etc. Février, 1790. Tome.XXXVI.p.109. Zimmerman. Voyage à la Nitrière naturelle qui se trouve à Molsetta.

the time. Cronstedt, the mineralogist, had suggested such an origin in 1758; and Darwin's friend Whitehurst accepted it.[1] Darwin, however, besides declaring that "The production of iron from the decomposition of vegetable bodies is perpetually presented to our view",[2] also suggested that manganese, calamy, and even copper and lead might be thus produced. The Additional Note on Iron[3] contains a mass of detailed observation and conjecture concerning the formation of iron-nodules, together with some account of the process of steel-manufacture, largely derived from William Nicholson's First Principles of Chemistry, published in 1789. The process is graphically described in the verse:

"HENCE dusky IRON sleeps in dark abodes,
And ferny foliage nestles in the nodes,
Till with wide lungs the panting bellows blow,
And waked by fire the glittering torrents flow;
- Quick whirls the wheel, the ponderous hammer falls,
Loud anvils ring amid the trembling walls,
Strokes follow strokes, the sparkling ingot shines,
Flows the red slag, the lengthening bar refines;
Cold waves, immersed, the glowing mass congeal,
And turn to adamant the hissing Steel."[4]

Then follows an account of the making of artificial magnets:

"Last MICHELL'S hands with touch of potent charm
The polish'd rods with powers magnetic arm;
With points directed to the polar stars
In one long line extend the temper'd bars;
Then thrice and thrice with steady eye he guides,
And o'er the adhesive train the magnet slides;
The obedient Steel with living instinct moves,
And veers forever to the pole it loves."[5]

---

(1) Whitehurst, op.cit., 1786. p.204.
(2) E.V.II. 1.183, n.
(3) E.V. Add.Note XVIII.
(4) E.V.II. ll.183-192.
(5) E.V.II. ll.193-200.

John Michell, born in 1724, was Fellow and Tutor of Queens' College, Cambridge, when Darwin entered the University in 1750. He was well-known in scientific circles, and in 1750 published A Treatise of Artificial Magnets, the work from which Darwin quotes. After Darwin settled in Lichfield Michell, whom Anna Seward describes as "skilled in astronomic science, modest and wise",[1] was a frequent visitor to his house, and the friendship lasted until Michell's death in 1793. This reference in The Economy of Vegetation is thus a personal tribute to a friend. In a footnote attached to the verse Darwin quotes a passage from Chambers' Dictionary on the history of the discovery of magnetism and the making of artificial magnets. He gives the outline of Michell's process, as described in the verse:

> "This method of rendering bars of hardened steel magnetical consists in holding vertically two or more magnetic bars nearly parallel to each other with their opposite poles very near each other, (but nevertheless separated to a small distance,) these are to be slided over a line of bars laid horizontally a few times backward and forward."[2]

Darwin now addresses Steel:

> "Hail, adamantine STEEL! magnetic Lord!
> King of the prow, the plowshare, and the sword!"[3]

---

(1) Anna Seward. Memoirs of the Life of Dr.Darwin.1804.p.16.
(2) E.V.II. l.193,n. The main substance of Darwin's note is taken from Ephraim Chambers' Cyclopaedia, or an Universal Dictionary of Arts and Sciences. 1778.art. Magnetism.
(3) E.V.II. ll.201-2.

This theme is expanded; and the lines, which are a glorification of science ancient and modern, reveal that Darwin belongs, poetically, to the classical tradition:

"By thee the plowshare rends the matted plain,
Inhumes in level rows the living grain;
Intrusive forests quit the cultured ground,
And Ceres laughs with golden fillets crown'd."[1]

This leads us to the most heretical article of Darwin's geological creed, the formation of flint and sand by the union of animal and vegetable acids with calcareous earth. No one else seems to have taken modern theory as far as this. Conservatives like Kirwan maintained that the original fluid Chaos had contained the eight generic earths and all the metals.[2] Advanced thinkers, such as Hutton, acknowledged the organic origin of limestone and coal. A few speculative geologists entertained the possibility of the vegetable origin of some metals. But no one but Darwin seems to have drawn this line of thought to a logical conclusion, and claimed an organic source for the other main constituents of the earth's surface (apart from granite, which all recognised as primary), sand and clay. Silicic acid had been discovered by Scheele in 1773; but silicon was not isolated until the early nineteenth century. So that when Darwin says that "though the presence of a siliceous acid and of a calcareous base have not yet been separately exhibited from flints," on the grounds of analogy "there can be little doubt of their

(1) E.V.II. ll.207-10.
(2) Kirwan, op.cit., p.11.

existence",[1] his suggestion is not, chemically speaking, outrageous, though it would never have proved acceptable to orthodox geologists. He argues that the acids produced by decomposing animal and vegetable matter have combined with calcareous rocks, which are also organic in origin, to form sand, flint and siliceous stones of various kinds such as amethyst, onyx, agate, mochoe and opal. These substances are therefore wholly organic, and were formed after life had existed on the earth for some ages. The acids may diffuse themselves in either liquid or gaseous form:

> "HENCE in fine streams diffuse ACIDS flow,
> Or winged with fire o'er Earth's fair bosom blow;
> Transmute to glittering Flints her chalky lands,
> Or sink on Ocean's bed in countless Sands."[2]

There follows a catalogue of precious and semi-precious stones formed by this process, which "only differ from flint by a greater or less admixture of argillaceous and calcareous earths. The different proportions of which in each kind of stone may be seen in Mr.Kirwan's valuable Elements of Mineralogy."[3] It is doubtful whether Mr.Kirwan, like de Luc, can have been pleased to find himself quoted in such a context; but the reference is indicative of Darwin's eclectic habit of mind. He can ignore a man's principles if he finds useful details in his work. This account of the formation of siliceous stones is adorned by a lengthy simile describing the

---

(1) E.V. Add.Note XIX. p.41.
(2) E.V.II. ll.215-18.
(3) E.V.II. l.215.n. Kirwan's Elements of Mineralogy was published in 1784.

loves of Jupiter, which is considered elsewhere.[1] Darwin then passes on to clay.

He believes clay to have been produced by morasses. After the passing of water through the morass had washed away the vegetable acids, a fermentation took place. Darwin assumed the fermentation on the analogy of new hay. Parts of the morass actually became ignited, and this caused the evaporation of the inflammable parts, sulphur, bitumen, and oils. The fixed part, clay, was left behind.[2] This is the nearest Darwin comes to a definition of the substance, but it is a chemical definition. His geological theory is a good illustration of his grasp of the relationships between the sciences. He conceives the earth's surface as a product of a combination of physiological and chemical processes. In verse, he addresses the Gnomes:

> "GNOMES! as you pass'd beneath the labouring soil,
> The guards and guides of Nature's chemic toil,
> YOU saw, deep-sepulchred in dusky realms,
> Which Earth's rock-ribbed ponderous vault o'erwhelms,
> With self-born fires the mass fermenting glow,
> And flame-wing'd sulphurs quit the earths below.
> HENCE ductile CLAYS in wide expansion spread,
> Soft as the Cygnet's down, their snow-white bed";[3]

At this point there is a long digression concerning Josiah Wedgwood and his art as a potter. This passage will be discussed later.[4]

---

(1) See below, The Heathen Mythology. p.180
(2) E.V. Add. Note XX.
(3) E.V.II. ll.271-78.
(4) See below, Wedgwood, Friend of Art.

The doings of Wedgwood are followed by the formation of coal, naphtha, jet, amber and other products of morasses:

"HENCE sable COAL his massy couch extends,
And stars of gold the sparkling Pyrite blends;
Hence dull-eyed Naphtha pours his pitchy streams,
And Jet uncoloured drinks the solar beams,
Bright Amber shines on his electric throne,
And adds ethereal lustres to his own."[1]

These substances, Darwin explains, are all formed as the result of fermentation in a morass. The inflammable parts of these vegetable deposits are evaporated by heat; if there is an impervious stratum above the morass, they become condensed below it, the finest vegetable oils becoming petroleum and naphtha, the less fine becoming jet, amber and coal. The derivation of these substances from vegetable oils is also given by Buffon,[2] from whom Darwin's theory appears to be in part derived.

Amber was of special interest at the time, since it was the substance which had given its name to the science of electricity, the study of "ethereal lustres". Jet, too, affords a reference to the popular eighteenth century study of optics, since black objects had been known since the time of Newton to be those which entirely absorb light. Coal, to which one line of verse is allocated, is treated at great length in an Additional Note, where Darwin sets out his theory of its origin in great detail, and records some

---

(1) E.V.II. 11.349-54. and see E.V.II. 1.353,n.
(2) Du Charbon de Terre. Oeuvres Complètes. 1878. Vol.II. p.125.

conjectures about "a fountain of fossil tar, or petroleum, discovered lately near Colebrook Dale, in Shropshire".[1] Particulars of this had been sent to him by his son, Robert Darwin, from Shrewsbury. The note is concluded by four lists of the strata revealed by borings of coal-mines, which Darwin had obtained from various places. He justly remarks that "the terms are not very intelligible, being the language of the overseers of coal-works."[2]

Much light is thrown on this Additional Note by J.E. Stock's Memoirs of the Life of Thomas Beddoes, published in 1811, which contains extracts of some of the letters which passed between Beddoes and Darwin. Stock says that the acquaintanceship appears to have begun about 1787, when Beddoes, after completing his medical studies in Edinburgh, was appointed Reader in Chemistry in the University of Oxford. His vacations were spent chiefly with friends in Shropshire, where he may have come into contact with Robert Darwin or his father. He was thirty years younger than Erasmus Darwin, but the latter thought very highly of his friend's abilities, and welcomed his criticisms and suggestions. One of the chief interests they had in common was the study of geology, and the first letter given by Stock is one in which Darwin suggests an exchange of fossils. Soon after this Beddoes was invited to stay in Derby, probably in the

---

(1) E.V. Add.Note XXIII p.60.
(2) Ibid., p.63.

summer of 1788. In the same letter in which this invitation is given, Darwin asks:

> "Have you any idea, how coals happen to lie stratified, as it were, with clay or sandstone? Could these alternate strata be made by depositions in the bottom of the sea? or has the phlogistic part of the coal been sublimed from clay, and condensed in a higher stratum? or lastly does not the goodness of the different strata of coal arise from their bitumen having been more or less evaporated by fire?"[1]

Beddoes' reply reveals that although he accepted the vegetable origin of coal, he leaned to the view that water had been the chief factor in producing the deposition of strata. Darwin perseveres, enlarges on his own theory, and explains that he has written a paper, intended for the Royal Society, on coal and on the tar-spring at Colebrook Dale, and suggests that if Beddoes has analysed this tar, he would be glad to add the results to his paper "where it would hang like a diamond in an Ethiop's ear."[2] Beddoes' answer is a complimentary reference "to the activity of that mind that rouses into action the powers of the people in and about Derby",[3] and a statement of complete disagreement with Darwin's theory. He honestly confesses that no part of the system pleases him, and refuses to see how any light could spring from the analysis of the tar. Darwin was not deterred by Beddoes' objections. The Additional Note on coal part of which is dated July, 1788, evidently

(1) J.E.Stock. Memoirs of the Life of Thomas Beddoes. 1811. Appendix 6. p.XXXVI.
(2) Ibid., p.XXXVIII.
(3) Ibid.

contains the material intended for the Royal Society, but which was not published in the Philosophical Transactions. The correspondence illustrates, at least, the undeveloped and uncertain state of contemporary geological chemistry, though the details of the theory, as set out in the Additional Note, are of little relevance to the poetry.

The reference to amber and electricity serves to introduce the subject of American Independence, since Benjamin Franklin, who had demonstrated the electrical nature of lightning, was also the representative of the American Colonies in England. By such links is the poem held together. A tribute to "Immortal Franklin", a celebration of the return of Liberty, and Liberty becomes a warrior who,

> "With bending sails
> Helm'd his bold course to fair HIBERNIA'S vales;-"

then a Giant who

> "on GALLIA'S plains
> Inglorious slept, unconscious of his chains;"

until

> "- Touch'd by the patriot flame, he rent amazed
> The flimsy bonds, and round and round him gazed";[1]

To a reference to the Bastille is appended a quotation from the Letters from France of Helen Maria Williams, published in 1790, describing an inspection of the prison after its fall.[2] Miss Williams was a friend of Anna Seward,

---

(1) E.V.II. 11.355-86.
(2) E.V.II. 1.383, n.

so that it is quite possible that Darwin was personally acquainted with her. In any case, the Letters were much discussed at the time by supporters of the Revolution, and the whole of this passage on Liberty is an eighteenth century tradition. Darwin had good precedent in Thomson's Liberty and Cowper's Task.

After this, it is with something of a wrench that we are brought back to the Gnomes, and the formation of metals. Darwin explains that granite and limestone rocks are found to be cracked to great depths, presumably as the result of subterraneous fires. In the cracks are found most of the metallic ores, except for iron and manganese, which have already been accounted for.

> "And up these cracks", Darwin says, "I suppose certain vapours arise, which either alone, or by meeting with something descending into them from above, have produced most of the metals; and several of the materials in which they are bedded."[1]

He then points out that no metallic ores are found in the highest mountains of granite, which on account of their early elevation, have probably never been covered with marine productions, and have not since, on account of their coldness, supported animal or vegetable life. He cites Kirwan's

---

(1) E.V. II. 1.398, n.

Mineralogy as the source of this statement, which is not, however a fair representation of Kirwan, who simply states that the highest mountains of granite contain no metallic ores, and makes no reference to animal and vegetable matters. The basis of Darwin's theory of the production of metals was probably Hutton's suggestion that metallic veins in rocks might have been caused by the forcing up of fluid minerals by the force of heat into fissures above.[1] Darwin, however, wishes to establish the modern production of metals, and here he is probably following Whitehurst,[2] who believed that minerals were being formed in the limestone rocks of Derbyshire by the accretion of particles present in the water which passed through the limestone. But he does not suggest that the particles are of vegetable or animal origin, except in the case of iron.

In the verse, there is a brief description of this process of metal-formation, followed by a catalogue of metals, concluding with gold and silver:

> "- Whence roof'd with silver beam'd PERU, of old,
> And hapless MEXICO was paved with gold."[3]

Then comes a condemnation of Spain, which forms an interesting parallel to, and may possibly have been inspired by, a similar condemnation in Buffon's article on Gold in the Natural History.

---

(1) Hutton, op.cit., p.63.
(2) Whitehurst, op.cit., 1786, p.226.
(3) E.V.II. ll.411-12.

"Heavens! on my sight what sanguine colours blaze!
Spain's deathless shame! the crimes of modern days!
When Avarice, shrouded in Religion's robe,
Sail'd to the West, and slaughter'd half the globe."[1]

This is followed by a renewed plea to Britannia to hasten the abolition of the Slave Trade, a subject which Darwin has already dealt with in connection with clay and Wedgwood. The overthrow of Tyranny by the Justice of Heaven is then allegorised in a description of the fate suffered by the armies of Cambyses, sent to overwhelm Ethiopia, and plunder the temple of Jupiter Ammon.[2] The instance is perhaps apt, in that it illustrates the vengeance meted out to a former oppressor of the African peoples, but the connection is not stated specifically. The description of the sandstorm which overcame one of Cambyses' armies is based directly on passages from James Bruce's Travels to discover the source of the Nile.

The first of these is a description of a sandstorm, given in the fourth volume of the work, which Darwin quotes at some length. He gives the reader the exact reference. The second is an account, to be found in the first volume, of Cambyses' expedition into Africa. Bruce explains;

(1) E.V.II. ll.413-16. cf.Buffon. De l'Or. Oeuvres Complètes. 1878. Vol.II. p.330.
(2) E.V.II. ll.431-98.

> ". . . no sooner was he arrived at Thebes (in Egypt) than he detached a large army to plunder the Temple of Jupiter Ammon, the greatest object of the worship of these shepherds; which army utterly perished without a man remaining, covered, as I suppose, by the moving sands. He then began his march against the Macrobii, keeping close to the Nile. The country there being too high to receive any benefit from the inundation of the river, produced no corn, so that this part of his army died for want of provision."[1]

No reference is given to this in Darwin's footnote, but it was undoubtedly the inspiration of his account of Cambyses' two armies, the one attacked by the Fiend of Famine, the other buried beneath the sand. Bruce was nevertheless only the starting point. The verse description, with its personification and colourful detail, is essentially Darwin's own conception of the events.

The geological theory is now almost complete. After a brief recapitulation of the central tenet of Hutton's geological theory, the volcanic origin of granite, basalt and related rocks,[2] which agrees very well with his own view of the origin of the nucleus of the earth, Darwin passes on to an exhortation to the Gnomes to resume their charge of the plants which draw their nourishment from the earth.

---

(1) James Bruce. Travels to discover the source of the Nile in the Years 1768,1769,1770,1771,1772, and 1773. 1790. Vol.I. p.451.
(2) E.V. Add.Note XXIV.

(3) Chemistry

During the years immediately preceding the publication of The Botanic Garden a chemical revolution had taken place. It had begun with the scientific study of gases. In 1754 Joseph Black discovered what we now call carbon dioxide, and named it "fixed air"; in 1766 Cavendish isolated hydrogen and called it "inflammable air"; in 1772 Rutherford demonstrated the existence of the gas now known as nitrogen; and in 1774 Joseph Priestley made the discovery of oxygen, or "pure air". This was the turning point of chemical theory. It led to the overthrow of the theory that when a substance burns, something called "phlogiston" is lost, and the establishment of the modern theory of combustion. Priestley's discovery enabled Lavoisier to complete his new combustion theory, which he advanced in 1777, and proved correct in 1783 by demonstrating the composition of water. In 1787 the new Chemical Nomenclature drawn up by a group of French chemists, headed by Lavoisier, was published; and this forms the basis of the nomenclature in use at the present day. Thus, within a period of little more than thirty years, the whole face of chemical science was changed.

Darwin, as a man of science, was naturally interested in these new developments. He belonged, moreover, to a circle which had an immediate and practical concern with them. Josiah Wedgwood and Matthew Boulton were both eager to apply chemical knowledge to the improvement of industrial processes; James Watt, whose steam-engine owed much to Black's discovery of latent heat, was keenly interested in chemistry, and had anticipated Lavoisier's discovery of the composition of water; and James Keir, whose friendship with Darwin dated from their student days in Edinburgh, had opened a works for the manufacture of alkalis, and was the author of several books of chemical theory. In 1771 he had published A Dictionary of Chemistry, translated, with additions, from the French of P.J.Macquer. In 1777 he produced A Treatise on the various kinds of Permanently Elastic Fluids or Gases, and in 1789 he published the first part of his own Dictionary of Chemistry. The second part appeared in 1790, but publication was then discontinued, and the work was never finished. The group was completed by Joseph Priestley, who in 1780 took charge of a congregation in Birmingham, and there pursued his researches.

Soon after Priestley's arrival Darwin removed to Derby, so that there was probably no very close contact between the two men. Nevertheless, together with Wedgwood and other members of the group, Darwin gave financial support to Priestley's experiments; and he was among those who received copies of Priestley's works immediately after publication. It is not surprising, therefore, that we find some record of the acquaintanceship in the pages of The Botanic Garden.

In the fourth canto of The Economy of Vegetation, Darwin exclaims:

"SYLPHS! YOU, retiring to sequester'd bowers,
Where oft your PRIESTLEY woos your airy powers,
On noiseless step or quivering pinion glide,
As sits the Sage with Science by his side;
To his charm'd eye in gay undress appear,
Or pour your secrets on his raptured ear.
How nitrous Gas from iron ingots driven
Drinks with red lips the purest breath of heaven;
How, while Conserva from its tender hair
Gives in bright bubbles empyrean air;
The crystal floods phlogistic ores calcine,
And the pure ETHER marries with the MINE."[1]

A footnote[2] enumerates Priestley's discoveries, including that of oxygen, and refers the reader to the new edition of his Experiments on Airs, published in 1790. In the verse, Darwin alludes to three of these discoveries, allotting them two lines each, and they are therefore described imaginatively rather than scientifically. In 1772 Priestley had dissolved iron and other metals in nitric acid and had obtained a colourless gas which he found would combine with common air to form reddish-brown fumes. The combination was accompanied by a diminution of the volume of the two gases, and a release of heat. The new gas Priestley called "nitrous air", and it was soon realised that the diminution of volume was due to the absorption by the nitrous air of the oxygen of atmospheric air. Darwin's verse description of this chemical

(1) E.V. IV. ll.165-176.
(2) E.V.IV. l.166, n.

reaction is not quite accurate. He attributes the reddish colour, not to the fumes produced by the combination of the two gases, which Priestley had named "nitrous acid vapour", but to the nitrous air itself, which is a colourless gas. The image of the red lips is certainly vivid, but scientific exactitude is sacrificed to it. Darwin was evidently attracted by the poetic possibilities of the experiment, for another version of it is found in the second canto of the poem, where it forms a not altogether relevant addition to an account of nitre-beds. In this context the combination becomes a courtship:

> "As woos Azotic Gas the virgin Air,
> And veils in crimson clouds the yielding Fair,
> Indignant Fire the treacherous courtship flies,
> Waves his light wing, and mingles with the skies."[1]

These lines, together with the attached footnote,[2] which contains an account of the experiment similar to that appended to the shorter version, may have been written before the idea of a comprehensive tribute to Priestley was conceived, though they must have been composed after the publication of the French Chemical Nomenclature in 1787, since the term "Azotic Gas" is used. They give, at any rate, some indication of Darwin's unsystematic method of composition.

The second discovery mentioned in the verse is that of the evolution of pure air by aquatic plants. In 1778

(1) E.V.II. 147-50.
(2) E.V.II. 143, n.

Priestley had observed that aquatic plants growing in water containing dissolved fixed air gave off bubbles of pure air. He had also noticed that a certain green substance, found in ponds, did the same; but he was not satisfied until 1779 that this "green matter", the Conserva mentioned by Darwin, was actually a minute plant. Priestley considered the oxygen a product of respiration. Other scientists claimed, with equal justification, that plants gave off vitiated air in respiration. The contradiction was in part resolved by Ingenhousz, in 1779, who showed that pure air was evolved only in sunlight, and that in the dark plants gave off fixed air. No further solution was as yet chemically possible, and the facts as they were then known are explained in Darwin's footnote.

The third of Priestley's achievements to which Darwin alludes is the most famous of all, the discovery of oxygen. The reference in the verse, however, is not primarily to this, but to Lavoisier's application of the discovery to the theory of combustion. Lavoisier had shown that calcination consists in the combination of oxygen with a metal or other substance in burning. Priestley never accepted this explanation. To the last he clung to phlogiston, believing that the disappearance of oxygen during the process of combustion was due to its absorption of the phlogiston given off. Darwin's reference to the fact that "the pure ETHER marries with the MINE" would thus appear to be more in the nature of a reproach than a compliment. At the same time, however, the phrase "phlogistic ores" has a suggestion of the old theory about it. The lines may, in fact, represent an attempt on Darwin's part to reconcile the new theory with the old, and should be compared with an Additional Note attached to a line earlier in the poem, where he explains that

> "The disciples of Lavoisier pay homage to a plurality of phlogistons under the various names of charcoal, sulphur, metals, &c. Whatever will unite with <u>pure</u> air, and thence compose an acid, is esteemed in this ingenious theory to be a different kind of phlogistic or inflammable body. At the same time there remains a doubt whether these inflammable bodies, as metals, sulphur, charcoal, &c may not be compounded of the same phlogiston along with some other material yet undiscovered, and thus an unity of phlogiston exist, as in the theory of Stahl, though very differently applied in the explication of chemical phenomena."[1]

He adopts the new theory in essence, but attempts to express it in the old terminology. The new theory was made possible only by Priestley's discovery of oxygen, and this explains its introduction into the compliment. It was the most important advance in chemical science of the century; and it is paradoxical that it was never recognised by the man who had supplied the main evidence for it.

Much light is thrown on this passage of <u>The Botanic Garden</u> by a letter from Keir to Darwin,[2] undated, but

---

(1) E.V.Add.Note V.p.10.
(2) A.Moilliet. <u>Sketch of the Life of James Keir,Esq., F.R.S., with a selection from his correspondence.</u> Edited by Alexander Blair,and printed for private circulation. 1859.p.96.

evidently written when the poem was in process of composition. Darwin had sent Keir a rough draft of a tribute to Priestley, and had asked for details of his achievements. Keir was a friend of Priestley, and had at times assisted with his experiments. He could therefore be relied upon to produce accurate information. He replied to Darwin that Priestley was printing a new edition of his work on air (evidently that of 1790, to which Darwin is able to refer his readers in the footnote to the completed version of the compliment), and listed his chief discoveries. Darwin adopted the main points of Keir's list, and transferred them to his footnote, making slight alterations where necessary; for Keir, too, adhered to the phlogiston theory.

The second part of the letter is still more interesting. Keir says;

> "The compliment you mean to pay the Doctor is a very elegant one, and he deserves it greatly, for having maintained the English credit in natural philosophy, which, without him and CAVENDISH, would have sunk low. Since you desire me to criticise the lines, I proceed. Between the 4th and 5th lines I would insert to the following purpose: 'What though to vulgar eyes you are invisible and pellucid, having neither colours nor constant form to indicate your presence, but, Proteus-like, take the shape of every vase you enter and elude common observation, yet to his favoured sight you willingly appear, or pour your secrets in his raptured ear.'"[1]

The fifth and sixth lines of Darwin's compliment, as it stands in the final version, probably represent his adoption

(1) Ibid., p.98.

of this suggestion. Keir continues:

> "The next 6 lines are excellent, the 2 following not sufficiently clear... and therefore I would substitute the following thought: 'And how you sometimes insinuate yourselves into your earthly cells (lime, &c), where you lurk imprisoned and confined by chains of chemical attraction, and might forever remain unnoticed, if fire, acids or fermentation did not give you strength enough to break your fetters, and the elastic gas explode, mount on resounding wings, and rush abroad. Thus gunpowder exerts its destructive force, and fulminating gold makes hills re-echoe'."[1]

The six lines which Keir describes as "excellent" may be those devoted to Priestley's discoveries. The two unsatisfactory lines were evidently dropped; and Keir's suggestion of a poetic treatment of the expansive powers of gases may perhaps be embodied in Darwin's lines on sulphur, gunpowder and gold in the first canto of the poem.[2]

Meditating on the properties of oxygen, revealed by Priestley, and on its existence in the ores of metals, demonstrated by Lavoisier, Darwin proceeds to enlarge upon a possible use for this new gas. He thinks that it may be released from its combination with certain substances, such as manganese and minium, and used to supply a means of respiration "in large inverted ships or diving balloons",[3] in which adventurers will journey beneath the ocean. Thus;

---

(1) Ibid., p.98.
(2) E.V.I. 11.223-48 and 1.226, n., 1.242,n.
(3) E.V.IV. 1.195,n.

"Led by the Sage, Lo! Britain's sons shall guide
Huge SEA-BALLOONS beneath the tossing tide;
The diving castles, roof'd with spheric glass,
Ribb'd with strong oak, and barr'd with bolts of brass,
Buoy'd with pure air shall endless tracks pursue,
And PRIESTLEY'S hand the vital flood renew.-"[1]

The composition of water, which had been a subject of correspondence between Darwin and James Watt before the publication of Lavoisier's discovery,[2] also has a place in the poem. It is described in terms of a betrothal:

"NYMPHS! YOUR bright squadrons watch with chemic eyes
The cold-elastic vapours, as they rise;
With playful force arrest them as they pass,
And to <u>pure</u> AIR betroth the <u>flaming</u> GAS.
Round their translucent forms at once they fling
Their rapturous arms, with silver bosoms cling;
In fleecy clouds their fluttering wings extend,
Or from the skies in lucid showers descend;"[3]

So, too, a hypothetical chemical reaction between light and oxygen is described as a marriage. Darwin had evolved a theory that sunlight, which at the time was regarded as a material substance, effected a decomposition of the water transpired by plants. The oxygen present in the water united with light to form a gas, and hydrogen, the other constituent of water, was retained by the plant for use in its vital processes. The idea was ingenious, though there was no experimental evidence for it; and the verse description contains all the facts, as they were then known. These were, that plants give off oxygen, that this occurs only in

---

(1) E.V. IV. ll.195-200.
(2) See J.P. Muirhead. <u>The Life of James Watt</u>. 1858. p.392.
(3) E.V. III. ll.201-8.

sunlight, that green plants of both aerial and aquatic types are concerned, and that a gas consists of the combination of a substance with caloric, of which light was a form. Thus;

"SYLPHS! from each sun-bright leaf, that twinkling shakes
O'er Earth's green lap, or shoots amid her lakes,
Your playful bands with simpering lips invite,
And wed the enamour'd OXYGENE to LIGHT.-
Round their white necks with fingers interwove,
Cling the fond Pair with unabating love;
Hand link'd in hand on buoyant step they rise,
And soar and glisten in unclouded skies."[1]

The marriage metaphor, which comes in so conveniently for descriptions of chemical combinations, although fairly obvious in itself, was no doubt also suggested by The Loves of the Plants, where Darwin had employed it with great success.

The account of the production of oxygen is followed by a description of the part it plays in animal and plant respiration,[2] which Darwin rightly regards as identical processes. This reference, however, together with others in different parts of the poem,[3] suggests that there is some confusion in his mind between the new theory of respiration, established by Lavoisier in 1780, and according to which it was recognised as the same process as combustion, and an older theory, advanced by a Scottish

---

(1) E.V. IV. ll.31-8 and see l.34, n.
(2) E.V. IV. l.34, n.
(3) E.V. I. 226, n.; E.V.I. ll.399-402 and l.401, n.

chemist named Crawford in 1779, which was based on the acceptance of phlogiston.[1] In 1791, when the poem was published, "the new chemistry" was still a controversial subject, and although the overthrow of phlogiston had been accomplished experimentally and theoretically, its total banishment from the minds of those who had grown up in the days of its supremacy was a very different matter. A lively letter from Keir, however, dated March 15th 1790,[2] makes it quite clear that Darwin had been urging his friend to be converted to faith in the new chemistry, and indicates that he was familiar with Lavoisier's demonstration that respiration is a form of combustion. The letter is in itself an illustration of the uncertainty of opinion at the time. We have in The Botanic Garden, therefore, not a historical record of the progress of chemistry, but a reflection of the impact of the chemical revolution on educated minds of the day, and the picture includes the confusions and fluctuations in the mind of the contemporary observer.

There is much more of chemical fact and theory, expounded in notes and illustrated in verse. A slight tribute to Cavendish takes the form of the suggestion that there is

---

(1) See Adair Crawford. Experiments and Observations on Animal Heat, and the Inflammation of Combustible Bodies; 1779. p.72. ff.
(2) Moilliet, op.cit., p.108.

an exterior atmosphere of hydrogen beyond the common atmosphere.[1] A theory of the nature of explosions leads to an expression of belief that "the discovery of gunpowder has been of public utility by weakening the tyranny of the few over the many."[2] The Nymphs of Fire, who

> "...mark with shining letters KUNKEL'S name
> In the pale Phosphor's self-consuming flame."[3]

serve to introduce an account of the discovery and artificial production of phosphorus, drawn from Keir's translation of Macquer's Dictionary of Chemistry.[4] These two lines of verse, which did not pass unnoticed by the authors of The Loves of the Triangles,[5] were based upon Darwin's knowledge of the fact, mentioned in Priestley's History of Light and Colours, that

> "Kunkel also reduced his phosphorus into the form of larger stones, which being warmed by a person's hand, and rubbed upon paper, would describe letters that were very legible in the dark."[6]

Darwin omitted to explain this, so that the lines read a little strangely to the uninformed.

---

(1) E.V. I. 11.123-4 and 1.123,n.
(2) E.V. I. 11.223-52 and 1.242, n.
(3) E.V. I. 11.231-2.
(4) E.V. Add. Note X.
(5) See Poetry of the Anti-Jacobin. ed. L. Rice-Oxley. 1924. p.95. Ver. 56, n.
(6) Joseph Priestley. The History and Present State of Discoveries relating to Vision, Light, and Colours. 1772. p.585. (Vol.II.)

The entertainment value of chemistry is not overlooked, and the use of invisible inks for drawing pictures on fire-screens, which thus are transformed when they become heated, and the chemical reaction which produces "Diana's Tree" are made to provide decorative similes.[1] Both these reactions are described in terms of the Hermetic Art, a useful indication of Darwin's attitude to alchemy. The facts are drawn from Keir's Dictionary of Chemistry, according to Darwin's notes, though he probably means, in the first case at least, the translation of Macquer's work. He remarks, however, in the note on "Diana's Tree";

> "For other circumstances concerning this beautiful experiment see Mr.Keir's Chemical Dictionary, art. Arbor Dianae; a work perhaps of greater utility to mankind than the lost Alexandrian Library; the continuation of which is so eagerly expected by all, who are occupied in the arts, or attached to the sciences."[2]

The reference here is evidently to Keir's own work. Since, however, only a small part of this had been published, and since the articles were arranged in alphabetical order, other references[3] must be to Macquer, although, in fact, the translation was published anonymously.

Darwin lived in an exciting period in the history of chemistry, and his friendships with Watt, Keir, and other

---

(1) E.V. I. 487-96. and 1.487,n. E.V. IV. 551-60.
(2) Notes Omitted. p.115.
(3) cf. E.V. Add. Notes X, p.19; XVIII, p.38; XXIII, p.63; XXXIV, p.95.

enthusiasts, and particularly his contact with Priestley, must have made the chemical revolution a very real thing to him. Chemical theory is unpromising material for poetry, but although the verse perhaps fails to convey exact scientific instruction, something of the spirit of adventure in which Darwin approached the subject comes through the notes, and re-creates, for the modern reader, the scientific attitude of the eighteenth century.

(4) The Steam-Engine

Darwin had been closely associated with the progress of one of the greatest recent achievements of applied physics, the steam-engine invented by James Watt. About 1765 Matthew Boulton, owner of the great manufactory at Soho, and a close friend of Darwin, was considering the installation of a steam-engine in his works, to replace the expensive and inadequate horse-mill then in use. The engine Boulton had in mind was that designed by Newcomen; but in 1766 he was brought into touch with Watt, at that time living in Glasgow, who had recently completed his design of the first steam-engine with a separate condenser, both more powerful and less expensive in fuel than the Newcomen engine. The following year Watt visited Soho to discuss matters with Boulton; and there he was introduced to Darwin. This was the beginning of a lasting friendship between the inventor and the doctor. Although the design had been perfected, however, no workmen could be found in Glasgow competent to execute it; and Boulton therefore urged Watt to join him in the commercial production of steam-engines. Owing to business commitments, Watt was unable to leave Glasgow till 1774, but in that year he entered into partnership with Boulton, and in 1775 the first successful steam-engine was assembled at Soho. At first it was applied chiefly for the purpose of pumping Cornish mines; but in 1782 Watt obtained a patent for a rotary-motion engine, and Boulton began to consider its introduction into flour and cotton mills. And in 1786 the most powerful steam-engine yet designed was installed in the Albion flour mill, in Southwark. The engine, which for twelve years had been an enormous strain on Boulton's financial resources, now began to pay its way, and was rightly regarded as one of the scientific triumphs of the age.

Darwin had followed the progress of Watt's invention with enthusiastic interest, and saw in it a fit subject for insertion in his poetry. It was of scientific importance and of great topical interest; and it offered an opportunity for a tribute both to the genius of Watt and to the enterprise of Boulton. More than this, Darwin saw in it an instrument of man's conquest of his environment, a contribution to the future prosperity and happiness of the human race. Thus in the first canto of The Economy of Vegetation, devoted to the Nymphs of Fire - for it was Black's discovery of latent heat that had enabled Watt to complete his design - Darwin first pays poetic tribute to Sovery, inventor of the first steam-engine,[1] then gives in a note a brief history of its subsequent development, concluding,

> "A few years ago Mr.Watt of Glasgow much improved this machine, and with Mr.Boulton of Birmingham has applied it to variety of purposes, such as raising water from mines, blowing bellows to fuse the ore, supplying towns with water, grinding corn and many other purposes."[2]

These applications of steam-power are then celebrated in verse:

> "The Giant-Power from earth's remotest caves
> Lifts with strong arm her dark reluctant waves;
> Each cavern'd rock, and hidden den explores,
> Drags her dark coals, and digs her shining ores.-
> Next, in close cells of ribbed oak confined,
> Gale after gale, He crowds the struggling wind;
> The imprisoned storms through brazen nostrils roar,
> Fan the white flame, and fuse the sparkling ore.
> Here high in air the rising stream He pours
> To clay-built cisterns, or to lead-lined towers;
> Fresh through a thousand pipes the wave distils,
> And thirsty cities drink the exuberant rills.-
> There the vast mill-stone with inebriate whirl
> On trembling floors his forceful fingers twirl,
> Whose flinty teeth the golden harvest grind,
> Feast without blood! and nourish human-kind."[3]

---

(1) E.V. I. 11.253-62 and 1.254, n.
(2) E.V. I. 1.254, n.
(3) E.V. I. 11.263-78.

An Additional Note[1] gives fuller details of the history of the invention of the steam-engine, Watt's improvements of it, and Boulton's co-operation. Darwin the patriot is proud that

> "...future times may boast that this grand and useful engine was invented and perfected in our own country."[2]

Just before the poem went to the press, however, he was obliged to add,

> "...the Albion Mill is no more; it is supposed to have been set on fire by interested or malicious incendiaries, and is burnt to the ground. Whence London has lost the credit and the advantage of possessing the most powerful machine in the world!"[3]

This disaster had occurred in March 1791, and was probably, as Darwin suggests, the work of those who feared that the application of steam-power to flour-grinding would deprive the labouring classes of employment. Darwin himself regarded the future of the engine with optimism:

> "Soon shall thy arm, UNCONQUER'D STEAM! afar
> Drag the slow barge, or drive the rapid car;
> Or on wide-waving wings expanded bear
> The flying-chariot through the fields of air."[4]

He may be thinking of the steam-driven wheel carriage, for the conveyance of goods and passengers, for which Watt had taken out a patent in 1784. He did not execute his plan,

---

(1) E.V. Add. Note XI.
(2) Ibid., p.22.
(3) Ibid.
(4) E.V. I. ll.289-92.

but in the same year William Murdoch, one of Boulton's most skilled workmen, constructed an actual working model of a locomotive, though he, again, had not time to pursue the scheme. Watt had also experimented on the application of steam-power to navigation, but had finally decided that it was impracticable. Boulton, of course, had been besieged by inventions of everything from locomotives to flying machines, but found no design worth the execution. Darwin himself, in the days when Boulton was first investigating the possibilities of steam-power, had designed a "fiery chariot",[1] which he thought would not fail of success, and had offered to enter into partnership with Boulton in carrying out the scheme. There must have been a flaw in the design, for nothing more was heard of the chariot. This proved no check on his enthusiasm, and in <u>The Economy of Vegetation</u> he declares;

> "As the specific levity of air is too great for the support of great burthens by balloons, there seems no probable method of flying conveniently but by the power of steam, or some other explosive material; which another half century may probable discover."[2]

Boulton, to whose enterprise and initiative Watt's success was in part due, receives special mention as the constructor of "a most magnificent apparatus for Coining, which has cost him some thousand pounds."[3] The idea of this

---

(1) S.Smiles. <u>Lives of Boulton and Watt</u>. 1865. p.184.
(2) E.V.I. 1.254, n.
(3) E.V. I. 1.281, n.

had been conceived in the early days of his partnership with Watt. The manufacture of counterfeit money formed one of the minor industries of Birmingham in the mid-eighteenth century. Boulton himself had consistently refused orders for false coins, but he seized upon the idea of applying steam-power to the stamping of coins, and in 1786, having constructed his machinery, executed a contract with the East India Company for a hundred tons of copper coin. When a new gold coinage was contemplated he was authorised by the Privy Council to prepare specimen coins. His designs were officially adopted, and finally, in 1797, he was employed to execute a new copper coinage for Britain. Darwin describes Boulton's machinery at Soho, operated by steam, the Giant-Power:

> With iron lips his rapid rollers seize
> The lengthening bars, in thin expansion squeeze;
> Descending screws with ponderous fly-wheels wound
> The tawny plates, the new medallions round;
> Hard dyes of steel the cupreous circles cramp,
> And with quick fall his massy hammers stamp.
> The Harp, the Lily and the Lion join,
> And GEORGE and BRITAIN guard the sterling coin.[1]

A note adds that the coins are made

> "...with such superior excellence and cheapness of workmanship, as well as with marks of such powerful machinery as must totally prevent clandestine imitation, and in consequence save many lives from the hand of the executioner; a circumstance worthy the attention of a great minister. If a civic crown was given in Rome for preserving the life of one citizen, Mr.Boulton should be covered with garlands of oak!"[2]

---

(1) E.V. I. 11.281-88.
(2) E.V.I. 1.281, n.

Large numbers of people were executed yearly for false coining, and Darwin the philanthropist is quick to see the social value of Boulton's invention. His interest in experimental science and in the application of new discoveries to the improvement of material conditions, his humanism, and his own considerable ingenuity in mechanical invention, all contribute to the enthusiasm with which he hails the steam-engine as a benefactor of mankind, and to the warmth of his compliment to its perfector and his partner. Darwin belongs to the first generation of poets to find machines and industrial processes a fit subject for poetry. The time had not then arrived when sensation might be carried into the midst of the objects of science itself, in the way Wordsworth anticipated. But to Darwin, whose interest was focussed upon man's relation to society, and upon the external conditions which mould the life of a society, there could be no fitter employment for a poet, who was also a man in society, than the celebration of significant contributions to civilisation. So far he belongs to the eighteenth century. It is remarkable how successfully he adapts a poetic diction deriving from Pope, and the device of personification, which gives a factual, if not an emotional unity to the whole passage on steam-power, to the description of machines and mechanical processes. Furthermore, he follows up his account of the actual and possible applications of steam-power to the needs of daily life with a simile in which he describes the Labours of Hercules. As steam serves man,

> "So mighty HERCULES o'er many a clime
> Waved his vast mace in Virtue's cause sublime,
> Unmeasured strength with early art combined,
> Awed, served, protected, and amazed mankind.-"[1]

Darwin's subject matter belongs to a scientific and industrial age, but also to an age when science and industry were not yet divorced from the arts. Working in a classical tradition of didactic poetry, owing something to the complimentary and epistolary species of his period, he extends the conventional subjects of poetry to include the objects of science, in a way which no one else had so far achieved. But he does not, at the same time, dispense with the conventional classical images and references. The classical and the scientific, the old and the new, exist side by side, the one complementary to the other. Science has been absorbed into the classical mould, and has not yet shattered it. In the same way, painters of this period retained classical elements in their pictures of industrial processes; although eventually the classical became gradually less emphatic, and finally disappeared altogether.[2] Darwin stands only at the threshold of the Industrial Revolution. His impressions were formed in a different world, and his work

---

(1) E.V. I. ll.297-300.
(2) See Francis D.Klingender. Art and the Industrial Revolution. 1947. p.48ff. Also, for discussion of The Botanic Garden, pp.30-38.

illustrates the impact of the new upon the old. The Romantic poets, on the whole, ignored the changes wrought by science in man's condition, so that there has been long to wait for the fulfilment of Darwin's conception of science as material for the poet.

(5) Electricity

From the steam-engine Darwin passes immediately to electricity, which was probably the most popular branch of contemporary physics, and which also came within the province of the Nymphs of Fire. A century before the publication of The Botanic Garden, practically nothing was known of electricity. Since then, machines had been contrived for generating static electricity; it had been found that the electricity so generated could be conducted by certain substances and not by others; a chance experiment had resulted in the invention of the Leyden jar, the earliest form of condenser; a two-fluid theory had been put forward to account for the two different effects of what we now call positive and negative electricity; and finally, Benjamin Franklin had proved the electrical nature of lightning, and had substituted for the two-fluid theory a one-fluid theory, which accounted for electrical effects by assuming an excess or defect of a single fluid. Electricity was more than a scientific study, however. The ease with which impressive effects could be obtained, and ignorance of its potential dangers, added to the novelty of the subject, had made it a fashionable drawing-room entertainment. And most of Darwin's reading public must have been familiar with an electrical machine such as he describes:

> "NYMPHS! YOUR fine hands ethereal floods amass
> From the warm cushion, and the whirling glass;
> Beard the bright cylinder with golden wire,
> And circumfuse the gravitating fire."[1]

The electricity was produced by the friction of a rotating glass globe, or, as described here, in later models, a glass cylinder, against a leather cushion. In a machine described by Priestley[2] the charge was collected by pointed wires brushing the surface of the cylinder, and joined at a short distance from it. The wires thus formed a kind of wire "beard", which is evidently what Darwin is describing here. "Ethereal floods" of course refers to the "imponderable" electric fluid; and the footnote[3] attached to the lines suggests that Darwin had adopted Franklin's one-fluid theory. Electrical attraction was often compared to gravitational attraction, so that "the gravitating fire" would present no difficulties to Darwin's readers.

The two lines which follow, however, touch indirectly on a controversial point. Darwin explains that

---

(1) E.V.I. 11.335-38.
(2) Joseph Priestley. The History and Present State of Electricity. 1767. (3rd ed. 1775. Vol.II. p.95, and Plates VII and VIII).
(3) E.V.I. 1.335, n.

"Cold from each point cerulean lustres gleam,
Or shoot in air the scintillating stream."[1]

and refers the reader to an Additional Note,[2] where we are told that if electricity is supplied to an insulated metallic ball armed with a projecting point, the fluid can be seen in the dark to pass off from the point. Darwin then refers to "an idle dispute" concerning the shape of lightning conductors, and declares that pointed conductors are known to be more effective than those terminating in a knob. The dispute had originated between Benjamin Franklin, whose original conductor had been designed with a point, and Benjamin Wilson, a member of the committee of the Royal Society set up to advise the Government on the protection of the powder magazines at Purfleet against lightning. Wilson advocated blunt conductors, but Franklin's advice was followed, and pointed conductors were accordingly set up at Purfleet. Wilson continued to protest, and when war was declared between Great Britain and the American colonies, the dispute was removed from scientific circles, and became a political controversy, since Franklin represented the colonies. George III is said to have attempted to persuade the Royal Society to reverse its decision in favour of pointed conductors; and certainly he had blunt

---

(1) E.V.I. 11.339-40.
(2) E.V. Add. Note XIII.

conductors installed at Kew Palace. Darwin's reference to this dispute, and his declaration of the advantages of pointed conductors, is therefore an indication of his political views, as well as a statement of scientific fact.

Darwin next takes the opportunity to pay a compliment to a personal friend. Abraham Bennet, curate of Wirksworth, Derbyshire, had designed a gold-leaf electrometer, consisting of two strips of gold leaf enclosed in a glass vessel. The strength of an electrical charge conveyed to the cap of the vessel was shown by the divergence of the leaves, measured against a graduated scale. So Darwin addresses the Nymphs:

> "You bid gold-leaves, in crystal lantherns held,
> Approach attracted, and recede repel'd;"[1]

He describes the electrometer in a footnote, and refers the reader to Bennet's New Experiments on Electricity, published in 1789.[2] Darwin, Wedgwood and Priestley had been among the subscribers to this work; and in it Bennet explains that the "doubler of electricity", another contrivance designed by him,[3] had been improved as the result of suggestions made by Dr.Darwin. On one occasion an electrometer had been taken from Wirksworth to Etruria "in a portmanteau, on horseback, yet without injury."[4] Darwin's compliment is thus a graceful reply to the tribute offered to his

(1) E.V.I. 11.345-46.
(2) See Abraham Bennet. New Experiments on Electricity. 1789. Sections I and II.
(3) Ibid., Sections V and VI.
(4) Ibid., p.21.

assistance and ingenuity in Bennet's book.

Darwin then describes a popular form of electrical entertainment, the "electric kiss":

> OR, if on wax some fearless Beauty stand,
> And touch the sparkling rod with graceful hand;
> Through her fine limbs the mimic lightnings dart,
> And flames innocuous eddy round her heart;
> O'er her fair brow the kindling lustres glare,
> Blue rays diverging from the bristling hair;
> While some fond Youth the kiss ethereal sips.
> And soft fires issue from their meeting lips."[1]

Another popular amusement was to complete the circuit of a Leyden jar by a chain of people, hand in hand, "the circling band of youths and timorous damsels, hand in hand,"[2] as Darwin puts it. Then;

> "- Starts the quick Ether through the fibre-trains
> Of dancing arteries, and of tingling veins,
> Goads each fine nerve, with new sensation thrill'd,
> Bends the reluctant limbs with power unwill'd;"[3]

From this Darwin passes to a more sombre aspect of the subject. In 1753, Dr.Richman, Professor of Natural Philosophy at St.Petersburg, had been killed by electricity he had drawn from thunder-clouds:

> "NYMPHS! on that day YE shed from lucid eyes
> Celestial tears, and breathed ethereal sighs!
> When RICHMAN rear'd, by fearless haste betray'd,
> The wiry rod in Nieva's fatal shade; -
> Clouds o'er the Sage with fringed skirts succeed,
> Flash follows flash, the warning corks recede;
> Near and more near He ey'd with fond amaze
> The silver streams, and watch'd the saphire blaze;
> Then bursts the steel, the dart electric sped,
> And the bold Sage lay number'd with the dead! -
> NYMPHS! on that day YE shed from lucid eyes
> Celestial tears, and breathed ethereal sighs!"[4]

(1) E.V.I. ll.349-56.
(2) E.V.I. ll.361-62.
(3) E.V.I. ll.363-66.
(4) E.V. I. ll.371-82.

This elegiac passage must have struck the contemporary reader with a deeper awe than we can feel. Such "fearless haste" seems to us more than a little rash. But at the time the full danger of electricity was hardly realised, and the pioneers of the science exposed themselves boldly to its power. Richman's death is described in Priestley's History of Electricity,[1] which may have been Darwin's immediate source. He had elevated an insulated metallic rod to collect aerial electricity. To the top of the conductor he had fixed an electrometer, and he was examining this when a ball of blue fire jumped from the rod to his head, and killed him instantly. The electrometer consisted of a pair of linen threads, hanging from a wire, and terminating in a pair of cork balls. The strength of the charge was measured by the divergence of the threads. Hence "the warning corks recede".

This tribute to the first martyr of electricity is followed by a compliment to Franklin, who in 1752 had demonstrated the electrical nature of lightning:

"You led your FRANKLIN to your glazed retreats,
Your air-built castles, and your silken seats;
Bade his bold arm invade the lowering sky,
And seize the tiptoe lightnings, ere they fly;
O'er the young Sage your mystic mantle spread,
And wreath'd the crown electric round his head.-"[2]

---

(1) Priestley, op.cit., Vol.I. p.416.
(2) E.V. I. 11.383-88.

The lines are explained in a footnote describing Franklin's apparatus:

> "Dr.Franklin was the first that discovered that lightening consisted of electric matter, he elevated a tall rod with a wire wrapped round it, and fixing the bottom of a rod into a glass bottle, and preserving it from falling by means of silk-strings, he found it electrified whenever a cloud passed over it, receiving sparks by his finger from it, and charging coated phials."[1]

Darwin's admiration for Franklin's scientific achievements and political opinions dated from the earliest days of his residence in Lichfield. In the spring of 1771, Franklin visited the north of England and called on various eminent men, including Priestley and Darwin, and this no doubt added something personal to Darwin's feeling. Franklin's political ideals are celebrated elsewhere in the poem, where he is hailed as the upholder of liberty:[2] and his scientific theories, and experiments performed by him, are mentioned in several contexts.[3]

The whole passage on electricity is thus intensely topical. It includes many elements other than the purely scientific, and forms an interesting reflection of the tastes of the time. The notes attached to the verse are voluminous. Darwin touches on electrical theory, medical use of electricity and the human nervous system, the origin

---

(1) E.V.I. 1.383, n.
(2) E.V.II. 11.361-66.
(3) See E.V. Add. Notes I, p.4; VI. p.12; XIII, p.25; XXIX, p.75; XXXIII, p.87.

of fairy rings, at that time thought to be electrical phenomena, personal protection against lightning, and symbolism in painting. He had himself a considerable knowledge of electricity, and had contributed a paper on the subject to the Philosophical Transactions. And when he came to write The Temple of Nature he inserted in it a long Additional Note,[1] not altogether relevant to the subject-matter of the poem, in which he sets out a close and lengthy argument concerning the nature of electrical attraction. It is full of hypothesis and conjecture, but shows that he was acquainted with the latest developments of the science, the work of Galvani and Volta. This perhaps indicates that his original view that the principal function of poetry is to entertain, had given way to a desire to instruct, and to stimulate, not popular interest, but serious scientific inquiry.

(1) The Temple of Nature. 1803. Add. Note XII.

WEDGWOOD, FRIEND OF ART

The Botanic Garden owes much to the art of Josiah Wedgwood. Miss Eliza Meteyard, Wedgwood's biographer, declares that

> "In the pages of the 'Botanic Garden' are many descriptions which are clearly drawn not so much from classical sources as from Mr.Wedgwood's interpretations in cameo of the antique gems - as in the passages descriptive of Cupid snatching the lightning from Jupiter, Venus rising from the sea supported by Tritons, the Nereid on the Sea-Horse, and the Marriage of Cupid and Psyche. Of course the gems themselves were, if in the cabinets of our nobility, accessible to a man of Dr.Darwin's fame and position; but his life was, as we have shown, one of incessant professional occupation, and it is thus more likely that his descriptions were drawn from his friend's exquisite interpretation of the originals."[1]

The poem itself, and what we know of the relationship between Wedgwood and Darwin confirm this. Darwin probably made Wedgwood's acquaintance soon after his arrival in Lichfield. Their connection may in the first place have been that of doctor with patient; but by 1765 they were already old friends. At this time Wedgwood already enjoyed some reputation as the maker of the famous "cream-ware" services. He had been appointed Potter to the Queen, and had opened a warehouse in London for the exhibition of his ornamental ware. His business in Burslem had expanded to such an extent that he was looking out for new premises,

---

(1) Eliza Meteyard. The Life of Josiah Wedgwood. 1865. Vol.I. p.405.

and he finally bought the Ridgehouse Estate, two miles from Burslem, where he erected a new factory and built a village for his workmen. The new works, christened Etruria, were completed and opened in 1769. Meanwhile, in 1766 he had taken into partnership a Liverpool merchant called Thomas Bentley, Bentley was a man of wide knowledge and good artistic judgement. He had travelled, and he had a special interest in classical art, so that his guidance was invaluable when Wedgwood turned to the imitation and reproduction of classical gems and vases. The beginning of the partnership marked the opening of a new phase of Wedgwood's career. His contacts at Court gave him access to the cabinets of wealthy connoisseurs, and brought him to the notice of men like the Duke of Marlborough and Sir William Hamilton. With Bentley to rely on for the superintendence of the design of the cameos, intaglios, vases and other ornamental objects, he was able to devote his energies to the scientific side of the business, to experiments on different substances, and trials of new processes. His business expanded and his fame spread, until in 1789 he reached what he regarded as the culminating point of his career, the production of a perfect copy of the Portland Vase.

In 1765, however, when Darwin first appears in the Wedgwood correspondence, the greatest triumphs were yet to come, and the most arduous period of Wedgwood's life was just beginning. Darwin, always interested in his friend's affairs, was particularly anxious for Wedgwood's success, and his help was freely given. He performed tactful propaganda among his patients in support of the Trent-Mersey canal scheme, in which Wedgwood had a vital interest; he provided substances for experiment in the manufactory at Etruria; he designed a windmill for grinding flints for use in the ornamental works; and for years he attended Wedgwood's family in a professional capacity. The intercourse was advantageous on both sides. Wedgwood profited by Darwin's medical skill, and by his practical interest in the work carried on at Etruria; and Darwin's poetry benefited from his having access to the various books of Antiquities in his friend's possession and to the designs of Flaxman and other artists employed by Wedgwood, and from his being able to watch at first hand the production of the famous cameos, intaglios, Etruscan vases and other ornamental ware.

In 1773 Wedgwood published a Catalogue of Cameos, Intaglios, Medals, Bas-Reliefs, Busts and Small Statues produced at Etruria. A sixth edition was issued in 1787. If this catalogue is compared with a list of similes derived from classical myth, found in The Botanic Garden, the truth of Miss Meteyard's statement concerning the main source of Darwin's imagery becomes apparent. One example must suffice here. Darwin writes;

"So playful LOVE on Ida's flowery sides
With ribbon-rein the indignant Lion guides;
Pleased on his brinded back the lyre he rings,
And shakes delirious rapture from the strings;
Slow as the pausing Monarch stalks along,
Sheaths his retractile claws, and drinks the song;
Soft Nymphs on timid step the triumph view,
And listening Fawns with beating hoofs pursue;
With pointed ears the alarmed forest starts,
And Love and Music soften savage hearts."[1]

A footnote explains:

"Described from an antient gem, expressive of the combined power of love and music, in the Museum Florent."[2]

The reference is evidently to the print to be found in the second volume of Gorio's Museum Florentinum entitled Amor Citharoedus leonem domans. Wedgwood, however, was probably the immediate inspiration of Darwin's verse description. In the Catalogue, under Bas-Reliefs &c., we find

No.145. Cupid on a lion; or the power of love.[3]

Wedgwood's tablet was evidently redesigned from the print in the Museum Florentinum. A cameo of the same or similar design is reproduced in Miss Meteyard's Wedgwood and his Works,[4] and shows Cupid astride a lion, holding a lyre. The description of this gem might be compared with that of the Nereid on a sea-horse, in the previous canto of

---

(1) E.V. IV. ll. 253-62.
(2) E.V.IV. l. 254, n. See Antonio Francesco Gori. Museum Florentinum. 1731-66. Vol.II. Tab.I.I. and pp.5-7. The "ribbon-rein" was perhaps suggested by another print in the first volume of the Museum Florentinum, showing Cupid astride a lion, holding a rein in one hand and a short whip in the other. Vol.I. Tab.LXXVIII, VII, and p.154. Cupido Leonis domitor.
(3) J.Wedgwood. Catalogue of Cameos, Intaglios, Medals, etc. 1773 (6th ed. 1787. p.35).
(4) Eliza Meteyard. Wedgwood and his Works, 1873. Plate XV.

the poem, which is also taken from "an antique gem."[1] In both cases the picture is merely Darwin's starting point. He adds movement, sound and, in the second description, colour, and he provides the natural setting. His interest in the presentation of objects to the eye in poetry is not so much in the creation, or reproduction, of pure form or outline as in the evocation of visual images by suggestive detail of colour and movement.

Richard Lovell Edgeworth, who disagreed with Darwin's favourite dictum that "the Poet writes principally to the eye,"[2] nevertheless urged his friend to choose subjects which would allow full scope both to this theory and to his facility in description. Maria Edgeworth tells us that

> "When my father found that it was in vain to combat a favourite false principle, he endeavoured to find a subject, which should at once suit his friend's theory, and his genius. He urged Dr. Darwin to write a 'Cabinet of Gems'. The ancient gems would have afforded a subject eminently suited to his descriptive powers; admitting all his elegance and ingenuity of allusion and simile; employing his classical learning, and bringing into play the passions and imagination; with all of ancient history and tragedy, and all of modern poetry, which would have afforded ample range, and rich materials, for creative fancy. The Labours of Hercules - Venus rising from the sea - Medusa - the Barberini Vase, &c., and many others which he has introduced into his Botanic Garden, shew how admirably he would have succeeded, had he pursued the suggestions of his friend, to quit for nobler objects his vegetable loves."[3]

---

(1) E.V.III. ll. 277-96 and l. 277.n.
(2) L.P. Interlude I. p.48.
(3) <u>Memoirs of Richard Lovell Edgeworth, Esq.</u>, begun by himself and concluded by his daughter Maria Edgeworth 1820 (3rd ed. 1844. p.327).

Darwin did not follow Edgeworth's advice. But the descriptions from classical subjects provided by Wedgwood, which form the main body of the imagery in The Botanic Garden, and which are as a rule only very loosely attached to their scientific context, undoubtedly provided an outlet for his feeling for the classical, his interest in the visual arts, and his imaginative powers. They represent the point at which the poet and the student of the classics meet the man of science and the theorist. And a Cabinet of Gems, although undoubtedly suited to Darwin's capabilities as a poet, would not have represented all sides of his mind and tastes as well as the subjects which he did in fact choose.

In The Economy of Vegetation Darwin makes generous return for the inspiration he had received from Wedgwood's work. This takes the form of a long parenthesis, inserted in a dissertation on geology, describing Wedgwood's greatest achievement as a potter, the creation of a perfect copy of the Portland Vase, and paying tribute to his activities as a philanthropist.[1] Darwin's starting point is a scientific account, in verse and notes, of the formation of clay. From this he proceeds to ceramics, and explains how

> "- First CHINA'S sons, with early art elate,
> Form'd the gay tea-pot and the pictured plate;"[2]

---

(1) E.V.II. ll. 291-348 and Add. Note. XXII.
(2) E.V. II. ll. 281-2.

Imitations of Oriental china ware were much in demand in England during this period, and Wedgwood himself, at both early and late stages of his career, derived designs and patterns from the Chinese, and produced a large quantity of imitative work, for which there was a good market. An Additional Note, attached to Darwin's lines on Chinese porcelain[1] contains a highly technical description, no doubt derived from Wedgwood, of the materials and processes used in the art of enamelling.

From China Darwin turns to Etruria, which forms the link with Wedgwood's achievements. Sir William Hamilton, envoy to the Court of Naples, and a connoisseur of classical art, had spent some years in assembling a valuable collection of Etruscan vases. In order to make the designs accessible to a wider public than could obtain a personal view of the collection, he employed the best Italian and French artists to make drawings of the vases. Two folio volumes of plates were published in 1766, and two more in 1767.[2] The necessary letter-press was entrusted to a Frenchman named d'Hancarville, who had already written on ancient art, and was regarded as a sound scholar. It happened that Wedgwood was one of the first people in England to see the result of Hamilton's undertaking, for Hamilton gave the proofs of the plates to

---

(1) E.V. Add. Note XXI.
(2) _Collection of Etruscan, Greek and Roman Antiquities, from the Cabinet of the Hon. W. Hamilton, etc._

Lord Cathcart, and Lord Cathcart lent them to Wedgwood, who studied them carefully, with a view to copying and rivalling the masterpieces of Etruscan art. He may later have possessed a copy of the work. At any rate, we find that Darwin had read d'Hancarville's preliminary discourses to the published collection. A footnote[1] on the vases, ewers and urns of ancient Etruria is plainly derived from the discourses, to which he refers his readers. He adds a comment of his own:

> "The peculiar character of their earthen vases consists in the admirable beauty, simplicity, and diversity of forms, which continue the best models of taste to the artists of the present times; and in a species of non-vitreous encaustic painting, which was reckoned, even in the time of Pliny, among the lost arts of antiquity, but which has lately been recovered by the ingenuity and industry of Mr.Wedgwood."[2]

The reference is to the researches on encaustic painting which Wedgwood had been conducting about 1768. Several attempts had been made during the century to recover the secret of this process, and successful experiments had been carried out by Count Caylus, whose *Recueil d'Antiquités* Wedgwood bought in 1769. In this year Wedgwood perfected his own process, which differed from that of Caylus, and obtained a patent for it. He was now making "Etruscan" vases, which long continued to be one of his most popular productions, and the first generation of Darwin's readers

---

(1) E.V. II. 1. 291,n.
(2) Ibid.

would at once recognise the full force of the compliment contained in this note.

The work at Wedgwood's Etruria is next described, in an address to the Gnomes, dwellers in the realms of Clay:

> "GNOMES! as you now dissect with hammers fine
> The granite-rock, the nodul'd flint calcine;
> Grind with strong arm, the circling chertz betwixt,
> Your pure Ka-o-lins and Pe-tun-tses mixt;
> O'er each red saggars burning cave preside,
> The keen-eyed Fire-Nymphs blazing by your side;
> And pleased on WEDGWOOD ray your partial smile,
> A new Etruria decks Britannia's isle.-
> Charm'd by your touch, the flint liquescent pours
> Through finer sieves, and falls in whiter showers;
> Charm'd by your touch, the kneaded clay refines,
> The biscuit hardens, the enamel shines;
> Each nicer mould a softer feature drinks,
> The bold Cameo speaks, the soft Intaglio thinks."[1]

The lines provide evidence for Darwin's observation of the work carried on at Etruria, if nothing else. In an Additional Note he adds that

> "Ka-o-lin is the name given by the Chinese to their porcelain clay, and pe-tun-tse to the other ingredient in their China ware. Specimens of both these have been brought into England, and found to agree in quality with some of our own materials".[2]

This is probably a reference to the fact that specimens of kaolin and petuntse had been supplied to Wedgwood by John Bradley Blake, of the East India Company, when the former was engaged in the experiments which led to the production of the new "jasper" body, which was used for all the cameos and intaglios after 1775. Darwin explains that the kaolin

(1) E.V. II. ll. 297-310.
(2) E.V. Add. Note XXI. p. 52.

is identical with a clay found in Cornwall. He left a blank, in which the name of this Cornish clay was to be inserted, but which he evidently forgot to fill in. He no doubt intended to consult Wedgwood on the subject.

The "new Etruria" which Wedgwood had founded may have owed its name, according to Miss Meteyard, to Dr. Darwin, "whose love of classical allusion is well-known".[1] At any rate, Darwin had been consulted over the planning and lay-out of the new estate. From the cameos and intaglios produced there, Darwin turns to Wedgwood's philanthropic activities. He addresses his friend in a complex sentence, which is interrupted in the middle by a parenthesis of twenty-two lines on the Portland Vase. The Vase will be considered later. The main tribute is as follows:

"To call the pearly drops from Pity's eye,
Or stay Despair's disanimating sigh,
Whether, O Friend of art! the gem you mould
Rich with new taste, with antient virtue bold;
From the poor fetter'd SLAVE on bended knee
From Britain's sons imploring to be free;
Or with fair Hope the brightening scenes improve,
And cheer the dreary waste at Sydney-cove;
. . . .
Whether, O Friend of Art! your gems derive
Fine forms from Greece, and fabled Gods revive;
Or bid from modern life the Portrait breathe,
And bind round Honour's brow the laurel wreath;
Buoyant shall sail, with Fame's historic page
Each fair medallion o'er the wrecks of age;
Nor Time shall mar; nor steel, nor fire, nor rust
Touch the hard polish of the immortal bust".[2]

(1) Meteyard. The Life of Josiah Wedgwood. 1865. Vol. I. p. 492, note 2.
(2) E.V.II. ll. 311-18 and 341-48.

It was not altogether unpremeditated. In a letter dated June 28, 1789, Wedgwood says, in reply to a query put by Darwin;

> "You ask 'Was anything of consequence done in the cameo or medallion kind before you? In real stones & in imitation of real stones in paste, or in soft coloured glass, much has formerly been done, witness the Portland Vase and the numberless pieces of inferior note. Basso-relievos of various sizes have likewise been made of a warm brown earth of one colour. But of the improved kind of two or more colours, and a true porcelain texture, none were made by the ancients or attempted by the moderns that I ever heard of till some of them began to copy my jasper cameos."[1]

Part of this reply is attached as a note to the second of the two passages quoted above. Wedgwood's cameos were at this date, of course, famous throughout England, and various firms had produced cheap imitations of them. A particularly popular series was one of famous men of the day, modelled by Flaxman. The series included Franklin, Sir Joseph Banks, Dr. Solander and Priestley. But perhaps the best known of all the cameos were the two singled out by Darwin for special mention, The Slave, modelled in 1787, and Hope addressing Peace, Labour and Plenty, in 1789.

In 1787 the Society for the Abolition of the Slave Trade was founded, and among the members of its first committee was Wedgwood. He attended its meetings whenever he was in London, and organised propaganda in the country when he was

---

(1) Meteyard, op. cit., Vol. II. p. 525.

at home. In support of the cause he ordered Hackwood to design a seal for the Society, which was shown to the committee and officially approved in October, 1787. Hundreds of cameos bearing the design were distributed, according to Darwin "to excite the humane to attend to and to assist in the abolition of the detestable traffic in human creatures".[1] A print of the design is placed opposite his lines on the Slave, together with one of the second cameo mentioned by him.

In 1789 Sir Joseph Banks, President of the Royal Society, received from New South Wales some samples of the mineral substances of the country. These included a specimen of clay, which he forwarded to Wedgwood. Wedgwood made a trial of the specimen, found it to be of excellent quality, and used it for an issue of medallions, designed to encourage the nascent arts and manufactures of Australia and to inspire hope in the hearts of the convict settlers. The medallion, which was also intended as a compliment to the late Captain Cook, was modelled by Webber; and by November, 1789, the first issue was ready, and was sent to Sir Joseph Banks, to be despatched to Australia. Darwin records the main facts of these events in a note and adds that a print of the medallion "is prefixed to Mr. Stockdale's edition of Philip's Expedition to Botany Bay."[2] This was perhaps

---

(1) E.V. II. 1. 315.n.
(2) Ibid.

written before the idea of including a print in his own work occurred to him; for the print on the opposite page is "Copied from Capt. Phillip's Voyage to Botany Bay, by permission of the Proprietor."

Arthur Phillip was the first Governor of Botany Bay, and an account of the voyage of the first convict ship and of the establishment of the settlement was compiled by John Stockdale "from Authentic Papers which have been obtained from the several Departments" and published in 1789. Stockdale comments thus on Wedgwood's design, which appears on the title-page:

> "The elegant vignette in the title-page, was engraved from a medallion which the ingenious Mr. Wedgwood caused to be modelled from a small piece of clay brought from Sydney Cove. The clay proves to be of a fine texture, and will be found very useful for the manufactory of earthen ware. The design is allegorical; it represents Hope encouraging Art and Labour, under the influence of Peace,to pursue the employments necessary to give security and happiness to an infant settlement. The following verses upon the same subject, and in allusion to the medallion, were written by the author of The Botanic Garden, and will speak more powerfully for themselves than any encomium we could bestow."[1]

He then quotes a passage of twenty-six lines on Sydney Cove, written by Darwin,[2] which, according to Miss Meteyard, greatly pleased Wedgwood, and later met with the approbation of the Queen. The verses describe Hope, standing on a rock

---

(1) The Voyage of Governor Phillip to Botany Bay. 1789. Account of the Vignette. Advertisement. p.IV.
(2) Included in the 1795 edition of The Economy of Vegetation and placed at the end of the Additional Notes, p.114.

high above Sydney Cove. She prophesies:

"There shall broad streets their stately walls extend,
The circus widen, and the crescent bend;
There, ray'd from cities o'er the cultur'd land,
Shall bright canals, and solid roads expand.-
There the proud arch, colossus-like, bestride
Yon glittering streams, and bound the chafing tide;
Embellish'd villas crown the landscape-scene,
Farms wave with gold, and orchards blush between.-
There shall tall spires, and dome-capt towers ascend,
And piers and quays their massy structures blend;
While with each breeze approaching vessels glide,
And northern treasures dance on every tide!-"[1]

We must now consider the Portland Vase. In 1784 Sir William Hamilton had bought the Vase from the Barberini family, brought it to England, and sold it to the Dowager Duchess of Portland. In July, 1785, the Duchess died, and the Vase was again for sale, and Wedgwood, who had already been attempting an imitation of it from prints in Montfaucon, was anxious to buy it. Darwin, writing to him in the following January, remarked, "I shall be glad to hear that you have purchased at the price you wished the famous vase."[2] At the sale, however, Wedgwood was outbid by the Duke of Portland himself. But the Duke immediately afterwards lent the Vase to Wedgwood for him to copy.

Wedgwood was in touch with Sir William Hamilton, and wrote to him during 1786, describing the properties of the

---

(1) Stockdale, op.cit., Advertisement, p.V.
(2) Meteyard, op.cit., Vol.II. p.576.

jasper body of which the copy was to be made, and the process by which the light and shade of the original design were to be imitated, and asking Sir William's advice on various points. Experiments then proceeded, and nothing more was heard of the Vase till 1789. In October of that year the first perfect copy was achieved, and it was sent to Derby for Darwin's inspection, evidently under pledge of secrecy. Darwin, however, wrote to Wedgwood:

> "I have disobeyed you, and shown your vase to two or three, but they were philosophers, not cognoscenti. How can I possess a jewel, and not communicate the pleasure to a few Derby philosophers?"[1]

During 1790 more copies of the Vase were produced, and in 1791 one of the finest of them was taken to London and shown to the Queen. It was then placed in the rooms of the Society of Antiquaries, and its "entire similitude to the original"[2] was certified by Sir Joshua Reynolds. Probably not more than fifty copies were produced during Wedgwood's lifetime. (He died in 1795).

Darwin, who had watched the progress of the work, and who had been in Wedgwood's confidence from the beginning, was naturally interested in the Vase. In 1791, moreover, when <u>The Economy of Vegetation</u> was published, Wedgwood's achievement must have been a subject of conversation in many

---

(1) Ibid., p.581.
(2) Ibid., p.594.

fashionable drawing-rooms, and of great topical interest to lovers of the antique and amateurs of art. Articles on the Vase had begun to appear in the English press; and in 1788 Wedgwood himself had produced a pamphlet entitled Account of the Barberini, now Portland, Vase. Darwin's poetic reference was therefore excellently timed.

In his pamphlet Wedgwood records the details of the recent purchase of the Vase by the Duke of Portland, and explains that his object in writing is to collect and summarise the different accounts of it which had already been published, but which were not all available to the general public. He then reproduces in outline the theories of eminent critics of the past and of his own day, from the earliest account, by Girolamo Tezi, in 1642, to d'Hancarville's treatment of the subject in his Recherches sur l'Origine, l'Esprit, et les Progrès des Arts de la Grèce published in 1785. There had been many different conjectures, concerning both the nature of the vase itself, and the subjects depicted in the relief-work. Some writers had said that it was carved from a natural stone, others had argued, correctly, that it was made of glass. Wedgwood explains, that the matter of the vase is factitious is now well known, and proceeds to give his own account of its workmanship:

"The ground, or body, is a transparent blue glass, so deep in colour, that when looked down upon, or viewed by reflection, it appears black and opake. The raised figures are of a white glass, so far transparent, that the blue colour of the ground is seen through the thin parts of it, while the thick parts have sufficient opacity to conceal entirely the colour of the ground, and appear of a pure white.
...... it appears clearly to me, that the body of the vase was coated all over, as far as the bas-reliefs were intended to reach, with white glass..... and that the figures were afterwards produced in this coat, by cutting down to the blue ground in the manner of real cameos."[1]

Of the relief-work considered as a work of art, Wedgwood says,

"To the exquisite beauty of the sculpture, he [the artist] has thus been enabled to superadd the effect of light and shade, by cutting down the parts to a greater or lesser thinness, according as the shade was required to be deeper or lighter, that is, the blue underneath to be more or less visible through the semi-transparent white relief......The like effect is observable in the antique cameos, which were executed in the same manner... But the expence of working so large a vase in this manner would necessarily be so great; so much time, labour, and address, would be required for the production of a single piece; that I fear no modern artist, however capable of the execution, would engage in it."[2]

This passage, interesting in itself, is given additional interest by the fact that it forms the basis of Darwin's introductory remarks on the Portland Vase:

---

(1) J. Wedgwood. <u>Account of the Barberini, now Portland, Vase.</u> 1788? p.11. The date 1788 is queried in the British Museum Catalogue.
(2) Ibid., p.12.

> "The celebrated funereal vase, long in possession of the Barberini family, and lately purchased by the Duke of Portland for a thousand guineas, is about ten inches high and six in diameter in the broadest part. The figures are of most exquisite workmanship in bas relief of white opake glass, raised on a ground of deep blue glass, which appears black except when held against the light. Mr. Wedgwood is of opinion from many circumstances that the figures have been made by cutting away the external crust of white opake glass, in the manner the finest cameo's have been produced, and that it must thence have been the labour of a great many years."[1]

Darwin also makes use of d'Hancarville's account of the Vase, which was quoted by Wedgwood, but which he would probably have consulted in the original. D'Hancarville had been at some pains to show that the greatest period of Greek art had been the century before Alexander the Great, and that the Vase was produced during this period. Darwin states that

> "Some antiquarians have placed the time of its production many centuries before the christian aera; as sculpture was said to have been declining in respect to its excellence in the time of Alexander the Great."[2]

He also adopts something of d'Hancarville's theory of the original purpose of the vase. D'Hancarville, pointing out that the bottom of the vase was cemented on to the main body, had said that it had obviously been designed as a funerary urn. He disagreed, however, with the general opinion, which had originated with Girolamo Tezi, that the vase was made to contain the ashes of Alexander Severus, and that the relief work depicted incidents connected with his life and

---

(1) E.V. Add. Note. XXII. p.53.
(2) Ibid.

death, and put forward the suggestion that the figures on the vase bore some more general relationship to the subject of death, and represented, in fact, scenes from the underworld. The head on the bottom of the vase was that of Orpheus, who had instituted the mysterious worship of the infernal deities. The pictures round the side were of Eurydice and Orpheus, watched by Pluto, and of Pollux, talking to Alcestis and Tyro.[1] Darwin adopts d'Hancarville's view that the significance of the figures was general, and connected with death, but argues against the theory that they represented Orpheus. Other theories, such as that of Montfaucon, who had argued that they represented Leda and the swan, or that of Bartoli, who had suggested that the subject of the scenes was Pluto and Proserpine, he neglects. He adds one more hypothesis to the already large mass of conflicting theory and opinion, and advances the original view that the relief work represents the Eleusinian Mysteries, on which he comments thus:

> "These mysteries were invented in Ægypt, and afterwards transferred to Greece, and flourished more particularly at Athens, which was at the same time the seat of the fine arts. They consisted of scenical exhibitions representing and inculcating the expectation of a future life after death, and on this account were encouraged by the government, insomuch that the Athenian laws punished a discovery of their secrets with death. Dr.Warburton has with great learning and ingenuity shewn that the descent of Æneas into hell, described in the

(1) See Pierre François Hugues (known as d'Hancarville). Recherches sur l'Origine, l'Esprit et les Progrès des Arts de la Grèce. 1785. Vol.II. p.138, n, ff.

> Sixth Book of Virgil, is a poetical account of the representations of the future state in the Eleusinian mysteries. Divine Legation, Vol.I. p.210."[1]

William Warburton's Divine Legation of Moses, first published in 1738-41, was undertaken as an attack on deism and a defence of revealed religion. The author's argument involves a demonstration of the fact that all ancient religions, except that of the Hebrews, contained a doctrine of a future state of rewards and punishments; and he shows that in Greece this doctrine was taught by means of the Mysteries, which were encouraged by civil legislators because the expectation of a future life was an incentive to good behaviour in the earthly one. The connection between this theme and the sixth book of the Aeneid is stated as follows:

> "It now being understood that the Aeneis is in the style of ancient legislation, it is hard to think so great a master in his art would overlook a DOCTRINE, which, we have shown, was the foundation and support of ancient politics; namely that of a future state of rewards and punishments."[2]

The allegorical descent of Aeneas into hell, therefore,

> "is no other than an enigmatical representation of his INITIATION INTO THE MYSTERIES."[3]

Warburton goes through the sixth book of the Aeneid, to show how it symbolises, in each detail, the progress of the rites of the Mysteries.[4]

---

(1) E.V.Add. Note XXII. p.53.
(2) William Warburton. The Divine Legation of Moses. 1738-41 (4th ed. 1755-88. Vol.I. Part I. p.226. This is the edition which Darwin used.).
(3) Ibid.
(4) Ibid., pp.210-296.

Darwin, with an ingenuity equalling that of Warburton, adapts this theory to explain the figures on the Portland Vase. Using the Divine Legation as a basis, he sets out to show that the seated woman, holding an inverted torch, is an emblem of Mortal Life. The figures on either side of her are "Eleusinian emblems of HUMANKIND, with their backs toward the dying figure of MORTAL LIFE, unwilling to associate with her, yet turning back their serious and attentive countenances, curious indeed to behold, yet sorry to contemplate their latter end."[1] The other side of the Vase shows the Manes on his first entrance into the infernal regions. He is received by Immortal Life, symbolised by a beautiful female who fondles a serpent, emblem of renovated youth. The other figure in this group is Pluto, whom Darwin describes in the words of d'Hancarville;[2] though he does not adopt d'Hancarville's interpretation of the group as a whole. The symbolism which Darwin attaches to the inverted torch is also quoted from the French scholar.[3]

In support of his argument that the figures on the Vase are connected with the Mysteries, Darwin explains that

---

(1) E.V.Add. Note XXII. p.55.
(2) d'Hancarville, op.cit., Vol.II. p.149.
(3) Ibid., p.154.

"... as these were emblematic exhibitions they must have been as well adapted to the purposes of sculpture as of poetry, which indeed does not seem to have been uncommon.... The procession of torches, which according to M. De St.Croix was exhibited in these mysteries, is still to be seen in basso relievo, discovered by Spon and Wheler. Memoires sur le Mysteres par De St.Croix. 1784. And it is very probable that the beautiful gem representing the marriage of Cupid and Psyche, as described by Apuleus, was originally descriptive of another part of the exhibitions in these mysteries, though afterwards it became a common subject of antient art. See Divine Legat. Vol.I. p.323. What subject could have been imagined so sublime for the ornaments of a funereal urn as the mortality of all things and their resuscitation? Where would the designer be supplied with emblems for this purpose, before the Christian aera, but from the Eleusinian mysteries?"[1]

He touches here on another part of Warburton's argument. Warburton had said that the Golden Ass of Apuleius was originally designed to encourage initiation into the mysteries, and that the story of Cupid and Psyche was "a philosophic allegory of the progress of the soul to perfection, in the possession of divine love and the reward of immortality."[2] But he had not suggested that the common representation of Cupid and Psyche in ancient sculpture had any direct connection with the Mysteries.

De St.Croix, the other author mentioned by Darwin, had said, in describing the Eleusinian rites;

"Les initiés tenoient une torche à la main, & défiloient ainsi deux à deux, comme on le voit sur le bas-relief découvert par Spon et Whéler, peut-être le seul monument rélatif aux Eleusinies, dont nous ayons connoissance."[3]

(1) E.V. Add. Note XXII. p.54.
(2) Warburton, op. cit., Vol.I. Part I. p.323.
(3) Guilhelm de Clermont Lodère, Baron de Sainte-Croix. Mémoires pour Servir a l'Histoire de la Religion Secrete des Anciens Peuples; ou Recherches Historiques et Critiques sur les Mysteres du Paganisme. 1784. p.197.

We can thus see how Darwin came to link the Portland Vase with the Mysteries. His interest in the gems of antiquity and in Wedgwood's reproductions of them, particularly of the Marlborough gem of Cupid and Psyche; the statement of De St.Croix that the bas-relief discovered by Spon and Wheler was the only pictorial representation of the Mysteries; Warburton's theory that Cupid and Psyche were connected with the rites, and his exposition of the sixth book of the _Aeneid_ as an allegory of them; all these, combined, were quite enough to arouse Darwin's love of a theory, and to stimulate his skill in conjecture. The result is an extremely complex hypothesis, set out in great detail in an Additional Note on the lines of verse devoted to the Portland Vase. The main sources of the Note are three in number. Wedgwood affords technical information, and the background of historical knowledge of earlier theories concerning the figures on the Vase. Warburton supplies the main theme of the argument; and d'Hancarville is brought in to reinforce Warburton and to supply details.

The figure on the bottom of the Vase is used as additional proof. Darwin declares that it represents a priestess or hierophant. De La Chausse, in his _Museum Capitolinum_, had said that it resembled Attis, and Wedgwood had quoted this remark in his pamphlet.[1] Darwin turned to

---

(1) Wedgwood, op.cit., p.16.

Danet's Dictionary of Greek and Roman Antiquities, and with its aid managed to prove that Attis was "the first great hierophant, or teacher of mysteries."[1] He confirmed this statement by reference to a print of another figure of Attis, this time to be found in Gori's Museum Etruscum. These books of antiquities were probably in the possession of Wedgwood or of his partner Bentley, or had been borrowed by them at some time. What directed Darwin's attention to Warburton we do not know. It may have been Warburton's treatment of hieroglyphics, a subject in which Darwin was interested. At any rate, having read the Divine Legation, he would no doubt read other recent and available books on the Mysteries, such as that of De St.Croix.

The argument of the Additional Note on the Portland Vase is lengthy and involved. It includes a fund of illustration, allusion and digression which is a strong proof of Darwin's classical knowledge, and is a good example of the interest of classical students of his century in the relation between ancient art and ancient literature. The Note is illustrated by four prints of the Vase, which must have proved a great attraction to scholarly and artistically minded readers of the poem. The lines of verse devoted to the subject consist of a description of "the fine forms on PORTLAND'S mystic urn."[2] One of the

(1) E.V.Add. Note XXII. p.59.
(2) E.V. II. l. 320.

groups of figures is depicted thus:

> "Here by fall'n columns and disjoin'd arcades
> On mouldering stones, beneath deciduous shades,
> Sits HUMANKIND in hieroglyphic state,
> Serious, and pondering on their changeful state;
> While with inverted torch, and swimming eyes,
> Sinks the fair shade of MORTAL LIFE, and dies."[1]

It can be seen that the verse follows the theory very closely. The use of the word "hieroglyphic" in this context, to describe a sculptured figure of symbolic significance, reminds us of Darwin's interest in hieroglyphics and mythology, and suggests that it was in pursuit of this subject that he had come across Warburton's theory of the allegorical meaning of the sixth book of the Aeneid.[2]

There is an interesting reference to Darwin's lines on the Portland Vase in a letter from Maria Edgeworth to her cousin Sophy Ruxton, dated August 14th 1792. She says;

> "Lovell [her brother] is perfectly well, and desires his kind love to you. Dr. Darwin has paid him some very handsome compliments in his lines on the Barbarini Vase, in the first part of the Botanic Garden, which my father has just got."[3]

Lovell Edgeworth was about seventeen years old at the time, and was the only son of R.L. Edgeworth by his first wife, Honora Sneyd of Lichfield. He was a gifted youth, and a great favourite of the doctor. A possible explanation of the reference in this letter is that Darwin had adopted some suggestion made by Lovell concerning the lines, during

---

(1) E.V.II. ll. 321-26.
(2) See below, The Heathen Mythology.
(3) Maria Edgeworth, Chosen Letters. ed. F.V. Barry. 1931. p. 57.

a visit to Derby. Or perhaps lines written by Lovell were actually incorporated into Darwin's description, though the style is uniformly that of Darwin himself.

The long digression on Wedgwood has, strictly speaking, no place in a scientific poem. In its context it constitutes an interruption of Darwin's already involved explanation of the formation of the earth's surface. But it is a very good example of his method of work, eclectic, discursive, even disjointed, and his interest in the ramifications and interconnections of every subject. His knowledge was not confined in compartments. Science and the arts are of equal interest and value to him. As a scientist, he investigated the formation of clay; as a man of artistic and literary culture, and as a humanist, he gloried in what man had done with clay. The passage illustrates, too, an attitude which seems especially characteristic of the minor poet or verse-writer of his century. He assumes, not only that the topical and the particular are fit subjects of serious poetry, but also that his readers would expect the poem to reflect the contemporary world of science and art, of fashion and philanthropy. He is able to assume a common interest and knowledge, a common background of polite learning. And the poet is expected to be a man of the world, addressing his readers on equal terms and in a common language, in a way that is personal, but not, after the fashion of a later age, personal only to the poet. The fact that Darwin was

Wedgwood's friend is not in itself sufficient to account for the inclusion in the poem of the Portland Vase, the medallion of the Slave, the affairs of Sydney Cove, although this is a graceful tribute. These topics are introduced by the poet as a member of society, speaking to and for society, though, no doubt, Darwin's attention was particularly drawn to them by his close knowledge of Wedgwood's work, and his own responsiveness to visual art.

THE HEATHEN MYTHOLOGY

In the Apology to The Economy of Vegetation Darwin explains:

> "Many of the important operations of Nature were shadowed or allegorized in the heathen mythology, as the first Cupid springing from the Egg of Night, the Marriage of Cupid and Psyche, the Rape of Proserpine, the Congress of Jupiter and Juno, Death and Resuscitation of Adonis, &c. many of which are ingeniously explained in the works of Bacon, Vol.V. p.47. 4th Edit. London, 1778.[1] The Egyptians were possessed of many discoveries in philosophy and chemistry before the invention of letters; these were then expressed in hieroglyphic paintings of men and animals; which after the discovery of the alphabet were described and animated by the poets, and became first the deities of Egypt, and afterwards of Greece and Rome. Allusions to those fables were therefore thought proper ornaments to a philosophical poem, and are occasionally introduced either as represented by the poets, or preserved on the numerous gems and medallions of antiquity."[2]

This interest in the fables of Egyptian and classical antiquity at first appears surprising in a man of advanced scientific opinion; and when, on reading the poem, we find that the Rape of Proserpine, introduced as a simile, is made to represent the union of oxygen with metals in calcination, that the Congress of Jupiter and Juno signifies the combination of hydrogen and oxygen to form water, and that the death and resuscitation of Adonis is an ancient

---

(1) Darwin's reference is incorrect. See Bacon. Works. 1778. Vol.V. pp.433-72. De Sapientia Veterum.
(2) E.V. p.[VII].

allegory of the principle of the conservation of matter, we find ever more difficulty in reconciling this attribution to the ancient Egyptians of what were in Darwin's day the latest discoveries of chemical science, with his theory of evolution and his strong faith in the future and in the inevitability of progress. This preoccupation with ancient knowledge, with symbols and hieroglyphics and allegory, suggests an esoteric knowledge, a cult of the past, not the critical spirit of scientific inquiry that we associate with Darwin. On examining the Apology more closely, we find that its implications are various. First, the poetic allusions to classical fable are intended primarily as ornament, and are not, therefore, put forward as part of the main body of scientific instruction. Then, we notice that they have been inspired in part by literary and pictorial representations; and it is evident that there is some debt to the activities and interests of Josiah Wedgwood. The most important facts that emerge, however, are that the ancient Egyptians were apparently possessed of an extensive knowledge of natural philosophy and chemistry in the period before the "invention" of alphabetic writing; that this knowledge was therefore recorded in hieroglyphics; that the original significance of these hieroglyphics was subsequently forgotten; and that they later gave rise to the

Love, represents the natural motion of the atom; Proteus stands for matter. There is obviously more behind Darwin's theory than The Wisdom of the Ancients. A key to the problem perhaps lies in the fact that Darwin is not concerned only with pagan myth. He regards the book of Genesis as a repository of Hebrew fable and allegory, to be interpreted historically or scientifically. Thus Abel was the name of an hieroglyphic figure representing the age of pasturage; Cain was the name of another hieroglyphic symbol, representing the age of agriculture. The creation of Eve from Adam's rib "might have been an hieroglyphic design of the Egyptian philosophers, showing their opinion that Mankind was originally of both sexes united, and was afterwards divided into males and females".[1] And again, Egypt is regarded as the source and fountain-head of knowledge. The belief, however, that the scientific knowledge attained by the Egyptian philosophers was afterwards lost, to be recovered only in the eighteenth century, suggests a cyclic, rather than a progressive theory of human history; and Darwin was certainly progressive, although it was natural that one whose faith in man's power to control his environment was so firm should also be interested in the past struggles of the human race, and in what appeared to his generation to be historical records of its achievements.

---

(1) The Temple of Nature. 1803. Additional Note X.

His whole conception and treatment of ancient myth does in fact reflect the struggle, which had first become acute in the previous century, between orthodox belief and the scientific attitude. The critical study of mythology had first been undertaken as a mode of defence and justification of the truth of the Bible. Myths had been shown to be corrupted versions of Hebrew history. The result of further investigation, however, was that Hebrew history came to be regarded as yet another mythology. Allegorical interpretation of the Scriptures, which had perhaps expressed a medieval mode of thought more easily than it did that of an age of reason, had come, during the eighteenth century, to suggest to the orthodox the work, if not of atheism, at least of a reprehensible deism. The spread of a spirit of scientific inquiry had nevertheless awakened a new interest in the early ages of the world and the history of man; problems of chronology became insistent; the relations between Scriptural record and the myths and fables of nations other than the Hebrews began to demand consideration. One result of this attempt to reconcile reason and revelation was the work of Jacob Bryant, whose *New System, or, An Analysis of Ancient Mythology*, was published in 1774-6. Bryant demonstrated, to his own satisfaction, that all myths could be resolved into variants of the Flood story, which had been recorded by the survivors of the catastrophe in hieroglyphics in various temples. In later times, he explained, old traditions were forgotten; Noah, formerly venerated as a patriarch, was worshipped as a god under the names of Zeus, Cronus, Osiris, Deucalion, and a host of other mythological characters; the meanings of the hieroglyphic records were lost, and fresh stories were invented to explain them; and idolatry reared its head. Thus the dove of the Flood story, called Ionah, in the Armonian language which Bryant imagined to have been the original tongue of the human race, became corrupted into Dione or Venus; and pictorial representations gave rise to the legend that Venus had been born of the sea.

This illustrates the extremes to which insistence on the literal truth of the book of Genesis could lead. The work is also interesting for the ideas it contains concerning hieroglyphics. An "hieroglyphic" appears to include all representations in painting or sculpture to which a story or meaning could be attached. Little was known at the time of true hieroglyphics. The Isiac Table had been discovered in 1525; Bacon had conjectured that hieroglyphics were "a kind of earlier born writing, and older than the very elements of letters;"[1] and Kircher, in the seventeenth century, had claimed to have discovered from the Table the darkest mysteries of Egyptian theology. It was not until 1799, however, that the discovery of the Rosetta Stone made possible a

(1) The Advancement of Learning. Book VI. Chap.I. The Works of Francis Bacon. Ed. Spedding, Ellis and Heath. 1875. Vol.IV. p.440.

scientific attempt to interpret the hieroglyphic characters. The attempt finally succeeded in 1823, when Champollion deciphered the records on the Stone. Meanwhile, "hieroglyphics" included everything from actual inscriptions to large sculptured figures. They were supposed, moreover, by many scholars, travellers and literary men, to conceal a profound knowledge formerly possessed by the Egyptian priests. Thus Claude Etienne Savary, author of Letters on Egypt, published in an English translation in 1787, declared that the man who should unveil this knowledge "would acquire immortal glory, by restoring to arts, sciences and history, so many discoveries lost to the world."[1] When Savary wrote this the whole question of ancient Egyptian knowledge had been a controversial one for many years. It had formed part of the dispute between Ancients and Moderns; it had been seized upon as a useful weapon by those who wished to disprove the historical authenticity of the Bible; and it had received the scorn of the more orthodox. Thus in 1671 Marius d'Assigny stated that all the humane sciences had flourished among the Egyptians and had been communicated by them to the Greeks.[2] In 1690 Sir William Temple declared that the priests of Aethiopia, Egypt, Chaldea, Persia, Syria and Judea had cultivated astronomy,

---

(1) Claude Etienne Savary. Letters on Egypt, 1785, translated 1787. Vol.II. p.481.

(2) Marius d'Assigny. A Short Collection of the Famous Mysteries of the Egyptians, Named Hieroglyphicks. 1671.

astrology, magic, geometry and natural philosophy.[1] On the other side, in 1694 William Wotton set out to show that there was no evidence that the Egyptians had possessed any sciences other than astrology and magic, and replied to the claims of the alchemists to derive their art from ancient Egypt, that although the chemical art might have originated in Egypt, it had certainly done so at a much later date than they pretended.[2] The Abbé Pluche, whose Histoire du Ciel appeared in 1739-41, put forward the theory that the hieroglyphics had originated as signs of the zodiac, or symbols of the seasons, hung out to inform the people of the times of sowing, harvesting, public feasts and ceremonies. He claimed, with perfect justice, that if his system were adopted, "the whole sum of the Egyptian wisdom falls to the ground."[3] Moses, he said, had provided "a plain and modest system of physicks",[4] sufficient for everybody. An immoderate thirst for knowledge leads only to the perversion of truth.

The alchemists' view of mythology and hieroglyphics, however, persisted into the eighteenth century. In a work entitled Les Fables Égyptiennes et Grecques Dévoilées & réduites au même principe; avec une Explication des

---

(1) Sir William Temple. Essays on Ancient and Modern Learning and on Poetry. Ed. J.E. Spingam. 1909. (Essay I. 1690)
(2) William Wotton. Reflections upon Ancient and Modern Learning. 1694.
(3) Noël Antoine Pluche. History of the Heavens. translated by J.D. de Freval. 1741. Vol.I. p.184.
(4) Ibid., Vol.II. p.225.

Hiéroglyphes et de la Guerre de Troye, published in 1758 A.J.Pernéty demonstrated that the myths of Egypt and Greece were nothing but allegories of the processes of the Hermetic art, invented by the priests to conceal their knowledge from the vulgar. Hieroglyphics were invented as a medium of secret record, by Hermes Trismegistus, discoverer of the Philospher's Stone. The legend of the Golden Fleece, the story of Midas, the theft of the golden apples of the Hesperides, and countless other fables, were thus simply allegories of the alchemical art.

A more moderate and scientific view of hieroglyphics was put forward by Warburton in 1738-41, in his Divine Legation of Moses. He emphatically denied that hieroglyphics were anything but a simple form of written communication, or picture-writing, belonging to the earliest days of civilisation. He compared the Egyptian hieroglyphics with the picture-writing of Mexico, and described how the original pictures were gradually modified into formal characters, and finally gave place to alphabetic writing.

It can be seen that there was a wide variety of opinion concerning the origin and nature of both myths and hieroglyphics, and the relation between them. Darwin's view of the hieroglyphics as "paintings of men and animals" in use before the invention of alphabetic writing evidently derives from Warburton. His belief that they were "described and animated by the poets, and became first the deities of Egypt, and afterwards of Greece and Rome" has much in common with Bryant's theory. His attribution to the Egyptians of a profound scientific knowledge, and particularly a chemical knowledge is at least not without precedent; what Pernéty had said of alchemy, Darwin was saying of chemistry.

This theory of an ancient knowledge, moreover, had not only persisted, but had been extended to refer to a period even earlier than the Egyptian civilisation. And this, not by men primarily interested in mythology, but by scientists and advanced thinkers. Voltaire regarded the Brahmins as the possessors of the most ancient civilisation. Jean Silvain Bailly, on the other hand, had developed a theory of a pristine culture existing among the peoples of the Caucasus mountains, some fifteen hundred years before the deluge. He had come to the conclusion that in studying ancient astronomy we discover not the beginnings, but the ruins of a science. The astronomical knowledge of the Egyptians, the Persians, the Chinese, was but a faint recollection surviving from a much earlier period.

> ...."le peuple qui tenait jadis le sceptre des sciences dans l'Asie, était l'auteur de toutes les idées philosophiques qui ont éclairé le monde.... il eut des sciences perfectionnés, une philosophie sage et sublime."[1]

---

(1) Jean Sylvain Bailly. <u>Lettres sur l'origine des sciences, et sur celle des peuples de l'Asie</u>. 1777. p.205.

These observations occur in _Lettres sur l'origine des sciences, et sur celle des peuples de l'Asie,_ published in 1777. The letters form part of a friendly controversy between Bailly and Voltaire on the question of an original civilisation. Bailly, however, was a friend of Buffon, and Buffon adopted his hypothesis of an ancient Asiatic culture. In his _Epoques de la Nature_, published in 1778,[1] Buffon stated that civilisation had originated in southern Siberia and northern Tartary, and had flourished for a period of between two and three thousand years before it was overwhelmed by an invasion of barbaric peoples from the north. There followed three thousand years of ignorance, during which traces of the perished culture survived and lingered on in the form of myths among different races. Six thousand years, moreover, was hardly a sufficient period to cover the whole history of man.

Thus Buffon found in this theory of an ancient and vanished civilisation a weapon of attack upon the view that the world had been created in 4004 B.C. When we remember that he had elsewhere declared that for countless ages before man appeared upon the scene the world had been evolving from a mass of material struck from the sun by the impact of a comet; and that he had outlined a complete

---

(1) _Septième et Dernière Epoque_. _Oeuvres Complètes de Buffon_. Paris. 1878. Vol.I. p.449 ff.

theory of organic evolution; and that Darwin had adopted much from both these theories; we can understand why Darwin also accepted the theory of the antiquity of scientific knowledge and its survival in myth. The existence of such a knowledge, whether Asiatic or Egyptian, was simply additional proof of the antiquity of man and of the earth. Hence the interest displayed by men of science in the unscientific theories of the mythologists. Darwin, perhaps through Wedgwood, was acquainted with the work of Bryant, Warburton, Pluche, Savary and other writers on hieroglyphics, and with many of the imposing volumes of antiquities published during the century. His attention was thus focussed on pictorial representations of classical and Egyptian myth, and he simply added what he found in Buffon to what he had assimilated from other sources. The belief that an advanced scientific knowledge could exist alongside a complete lack of alphabetic writing, which to us appears to involve some contradiction, obviously did not present the same difficulty to the mind of the eighteenth century; and Darwin's interest in the progress of writing is merely in keeping with his scientific approach towards the history of the arts and sciences. Moreover, his own eclectic habit of mind, together with the quantity and variety of available material enabled him to select what seemed useful, and to ignore arguments which were unacceptable. Thus he can quote an observation from Pluche's Histoire du Ciel,[1] and at the same time ignore the fact that it forms part of the argument by which Pluche claims to demolish "the whole sum of Egyptian wisdom".

There remains the fact, however, that Darwin appears to be alone in attributing to the ancient Egyptians a knowledge of the modern chemistry which was one of the major scientific triumphs of the twenty years preceding the publication of The Botanic Garden. This particular interpretation of mythology may have been suggested by the work of his friend John Whitehurst, who had evolved a theory, derived in part from Bacon's Wisdom of the Ancients that the Newtonian philosophy was known and used in a period earlier than the Phoenician and Egyptian nations, and had merely been rediscovered in the seventeenth century.[2] Whitehurst thus attributes to the remotest antiquity what were in his day the greatest achievements of modern physics; and Darwin does the same for chemistry.

Thus, complimenting Joseph Priestley upon his discovery of oxygen, Darwin explains that "the pure ETHER marries with the MINE",[3] refers to the combination of oxygen with

(1) E.V. III. l. 129.n.
(2) John Whitehurst. An Inquiry into the Original State and Formation of the Earth. 2nd ed. 1786. p.18.
(3) E.V. IV. l. 176.

metallic or inflammable bodies to form oxides, describes the Rape of Proserpine in verse reminiscent of Ovid and Milton, and comments;

> "From these fables which were probably taken from antient hieroglyphics there is frequently reason to believe that the Egyptians possessed much chemical knowledge, which for want of alphabetical writing perished with their philosophers."[1]

The whole passage is a very complex synthesis. Another example of the same type of simile is that in which the combination of oxygen with different substances to form acids is compared to the loves of Jupiter with terrestrial ladies.[2] Hebe, Leda, Olympia, Europa, and the rest, are hieroglyphic characters standing for sulphur, azote, carbon, and other substances with which Jupiter, or oxygen, will unite. Again, the combination of oxygen and hydrogen to form water is compared to the conjunction of Jupiter and Juno.[3] This myth, it may be noted, had been given an alchemical interpretation by Pernéty,[4] and a physical one by Thomas Burnet[5] and other writers, so that Darwin was but elaborating a well-established tradition.

In his interpretation of at least one myth Darwin

---

(1) E.V. IV. l. 178.n.
(2) E.V. II. ll. 229-270 and l. 229.n.
(3) E.V.III. ll. 211-260,and l. 260.n.
(4) Pernéty, Les Fables Égyptiennes et Grecques Dévoilées et réduites au même principe; avec une Explication des Hiéroglyphes et de la Guerre de Troye. 1758 (2nd ed. 1786. Vol. II., pp.79-81.)
(5) Thomas Burnet. The Sacred Theory of the Earth, 1684. (7th ed. 1759. Vol.I. p.247).

appears to owe a specific debt to Buffon. In the second canto of The Economy of Vegetation Darwin explains that as organic forms perish and decay the Gnomes

> "With fostering hand the parting atoms catch,
> Join in new forms, combine with life and sense,
> And guide and guard the transmigrating Ens."[1]

A note[2] refers the reader to Lavoisier's Traité de Chimie, where it is shown that all animal and vegetable bodies can be resolved into oxygen, hydrogen, carbon and azote. The circulation of matter had long been assumed; Lavoisier had demonstrated, in chemical terms, an actual conservation of matter, and this is implied in Darwin's lines. In a further note he adds that

> "The perpetual circulation of matter in the growth and dissolution of vegetable and animal bodies seems to have given Pythagoras his idea of the metempsycosis or transmigration of spirit; which was afterwards dressed out or ridiculed in variety of amusing fables."[3]

He then tells in verse the story of Venus and Adonis, gives some common interpretations of the myth, derived from Danet's Complete Dictionary of the Greek and Roman Antiquities, and suggests;

> "It seems more probably to have been a story explaining some hieroglyphic figures representing the decomposition and resuscitation of animal matter; a sublime and interesting subject, and which seems to have given origin to the doctrine of transmigration, which had probably its birth also from the hieroglyphic treasures of Egypt."[4]

---

(1) E.V.II. ll. 582-4.
(2) E.V.II. l. 577.n.
(3) E.V.II.l. 584.n.
(4) E.V.II. l. 586.n.

This was very probably inspired by a section of Buffon's article entitled Carnivorous Animals in the Natural History. Buffon says;

> "On ne peut pas douter, en ramassant les débris qui nous restent, que les sciences n'aient été très anciennement cultivées, et perfectionnées peut-être au-delà de ce qu'elles le sont aujourd'hui."[1]

He then explains that in the most remote antiquity it was known that all living creatures are composed of organic molecules which are indestructible, and which disperse when one organism perishes, only to form new organisms. This was written before Lavoisier had expressed the theory in precise chemical terms; but the principle is the same. Buffon, the friend of Bailly, holds that the theory of transmigration of souls, held by the Brahmins, is but a corruption, or very ancient tradition, of this original knowledge of the circulation of matter. Buffon may have derived this explanation from Pernéty, who had declared that Pythagoras himself had understood his doctrine of transmigration to refer, not to spirit, but to matter. And it is of course possible that Darwin himself was personally acquainted with Pernéty's work.

Darwin's debt to both mythologists and scientists is equally apparent when he turns to the physical interpretation of ancient fable. In the first canto of The Economy of Vegetation he explains that

---

(1) Oeuvres Complètes de Buffon. Paris. 1878. Vol. IV. p.10.

"From having observed the gradual evolution of the young animal or plant from its egg or seed; and afterwards its successive advances to its more perfect state, or maturity; philosophers of all ages seem to have imagined, that the great world itself had likewise its infancy and its gradual progress to maturity; this seems to have given origin to the very antient and sublime allegory of Eros or Divine Love, producing the world from the egg of Night, as it floated in Chaos."[1]

Later in the canto Eros is described in verse:

"Thus when the Egg of Night, on Chaos hurl'd,
Burst, and disclosed the cradle of the world;
First from the gaping shell refulgent sprung
IMMORTAL LOVE, his bow celestial strung; -
O'er the wide waste his gaudy wings unfold,
Beam his soft smiles,and wave his curls of gold;-
With silver darts He pierced the kindling frame,
And lit with torch divine the ever-living flame."[2]

A second note tells us;

"There were two Cupids belonging to the antient mythology, one much elder than the other. The elder cupid, or Eros, or divine Love, was the first that came out of the great egg of night, wich floated in Chaos, and was broken by the horns of the celestial bull, that is, was hatched by the warmth of the spring. He was winged and armed and by his arrows and torch pierced and vivified all things, producing life and joy. Bacon. Vol.V. p.197. Quarto edit. Lond. 1778. 'At this time, (says Aristophanes,) sable-winged night produced an egg, from whence sprung up like a blossom Eros, the lovely, the desirable, with his glossy golden wings'. Avibus. Bryant's Mythology, Vol.II. p.350. second edition. This interesting moment of this sublime allegory Mrs. Cosway has chosen for her very beautiful painting." [3]

---

(1) E.V.I. l. 101.n.
(2) E.V.I. ll. 413-20.
(3) E.V.I. l. 413.n.

A description of Mrs.Cosway's painting follows. It is thus evident that the immediate inspiration of Darwin's image was pictorial; though Bacon and Bryant have been made to contribute different elements of the notes. Moreover Thomas Burnet had explained, in his Theory of the Earth that the figure and internal form of the earth were known to the ancients, and were "comprized and signified in their ancient Doctrine of the Mundane Egg".[1] Darwin, however, had read Helvetius's De l'Esprit, and must have been familiar with Helvetius's statement that in the early periods of civilisation man expresses his conception of the operations of nature in terms of imagination. To primitive man the world appears to be governed by the personal actions of gods, goddesses, genii and daemons. In Greece, for example, imagination

> "inspired Hesiod, who, when full of his enthusiasm, said, 'In the beginning were Chaos, black Erebus and Tartarus. Time did not yet exist, when eternal night, which, on heavy and extended wings, roved through the immense plains of space, suddenly stopped at Erebus: she there deposited an egg: Erebus received it into her bosom, hatched it, and Love sprang from thence. He arose on his golden wing, united himself to Chaos: and this union gave being to the heavens, to the earth, to the immortal gods, to men, and to animals. Already Venus, conceived in the sea, arose on the surface of the waters; all animated bodies stopped to contemplate her; the emotions which love had impressed on all nature were then directed towards beauty. Now order, regularity and design were first known in the universe".[2]

---

(1) Burnet, op.cit., Vol.I. p.356.
(2) C.A.Helvetius. De l'Esprit 1758. (translated 1759. p.248).

Helvetius's interest in mythology sprang from his recognition of the importance to the scientist of the study of the development of the human mind from the savage state to the civilised. Similarly Darwin was concerned not only with how the earth took its present form, but also with the history of man's knowledge of the subject. The one study reinforces the other, and a supposition that a knowledge of geogeny and physics existed in times before the beginning of Hebrew history makes more real the concept of vast periods of time stretching back over countless ages, and lends additional force to a theory of a gradual evolution of the world and of man.

Helvetius's reference to Venus rising from the sea may have been noted by Darwin. In The Economy of Vegetation he describes the formation of the primitive islands, adds a simile describing Venus rising from the waters, and explains;

> "It is probable that this beautiful allegory was originally an hieroglyphic picture (before the invention of letters) descriptive of the formation of the earth from the ocean, which seems to have been an opinion of many of the most antient philosophers."1

In The Temple of Nature he provides another interpretation, and suggests that Venus represented the beauty of

---

(1) E.V.II. 1.47.n. Darwin mentions "an antient gem representing Venus rising out of the ocean supported by two Tritons". This may be that of which a print is to be found in the Polymetis of Joseph Spence. 1747. (2nd ed. 1755. Plate XXX. III.)

organic nature, elevated by earthquakes from the primeval ocean.[1] It would thus appear that he was not convinced of particular meanings to be attached to particular myths. It was the general idea of a scientific knowledge lost in the passage of time and recovered in his own age that appealed to him. It is interesting, too, in view of Darwin's statement that allusions to Egyptian and Greek fables were thought proper ornaments to a philosophical poem, to find that Helvetius declares that since imagination is no longer required to explain the mysteries of natural phenomena, its proper expression is in poetry, where "it shows how to represent everything by short images, or allegories, which are properly only continued metaphors."[2]

Darwin's treatment of the myth of Cupid and Psyche is extremely complex. In the fourth canto of The Economy of Vegetation he describes the union of the oxygen present in the water contained in the vessels of plants with light, to form pure air, or oxygen in its gaseous state. The union is described in terms of a marriage, and we are told that the resultant oxygen

> "With Life's first spark inspires the organic frame,
> And,as it wastes, renews the subtile flame."[3]

---

(1) T.N. I. l. 372.n.
(2) Helvetius, op.cit., p.249.
(3) E.V. IV. ll. 45-6.

There follows immediately a verse account of the marriage of Cupid and Psyche, inspired, as a footnote explains by "an antient gem on a fine onyx in possession of the Duke of Marlborough, of which there is a beautiful print in Bryant's Mythol. Vol.II. p.392. And from another antient gem of Cupid and Psyche embracing, of which there is a print in Spence's Polymetis. p.82."[1] The immediate inspiration, however, was more probably a reproduction of the Marlborough gem, modelled by Flaxman in 1770 for Wedgwood, in the form of an oval tablet of dark blue jasper showing the marriage of Cupid and Psyche in white bas-relief. This proved one of the most popular of Wedgwood's productions. In his verse Darwin reproduces the main features of the gem. The point of the simile is that as oxygen sustains and renews the life of the individual organism, so love and beauty, symbolised by Cupid and Psyche, maintain a perpetual renewal of organic forms:

> " - Hence plastic Nature, as Oblivion whelms
> Her fading forms, repeoples all her realms;
> Soft Joys disport on purple plumes unfurl'd,
> And Love and Beauty rule the willing world."[2]

To these lines is appended a quotation from <u>De Rerum Natura</u>:

---

(1) E.V.IV. l. 48.n.
(2) E.V.IV. ll. 59-62.

"Quae mare navigerum et terras frugiferentes
Concelebras; per te quoniam genus omne animantum
Concipitur, visitque exortum lumina solis."

Lucret.[1]

All this represents a very complex synthesis of material from Bryant. He had equated Ionah, or the dove of the Flood story, with Dione or Venus. Eros or Cupid, the companion of Venus, he had explained as a corrupted form of Iris, the rainbow which followed the Flood.[2] The rainbow represented divine love, with which man became reconciled; and the soul of man was portrayed in hieroglyphics under the form of Psyche, "the most pleasing emblem among the Egyptians."[3] The marriage of Cupid and Psyche was therefore originally a representation of the union of the soul with divine love. But since the institution of marriage commenced at the restoration of the world after the Flood, the ancients made it the prototype of their nuptial rites, and it was accordingly described as a real marriage. Darwin seized upon the suggestion offered by this explanation, and made Cupid and Psyche represent Love and Beauty, who by their union maintain and renew organic life. The symbolism is emphasised by the lines of Lucretius, which are addressed to Venus, quoted in the footnote, and of which his own lines are a

---

(1) E.V.IV. 1.60.n.
(2) Jacob Bryant. A New System, or, an Analysis of Ancient Mythology. 1774. Vol.II. p.283 ff.

(3) Ibid., p.388.

very free translation. The quotation is the more interesting in that it too may have been derived from Bryant. In the course of his demonstration of the identity of Venus and the biblical dove Bryant quotes the opening lines of De Rerum Natura, gives his own translation, and explains:

> "In the hieroglyphical sculptures and paintings where this history was represented, the Dove could not well be depicted otherwise than hovering over the face of the deep. Hence it is that Dione or Venus is said to have risen from the sea. Hence it is also, that she is said to preside over waters; to appease the troubled ocean; and to cause by her presence a universal calm: that to her were owing the fruits of the earth; and the flowers of the field were renewed by her influence."[1]

In The Temple of Nature Cupid and Psyche are introduced as "the Deities of Sexual Love" and their triumphal marriage progress represents a step in the evolution of organic life, the transition from solitary to sexual reproduction.[2] The original passage of description in The Economy of Vegetation is reproduced in outline, but with varied and added detail; Darwin explains that the description is in part taken from Bryant's Mythology, and summarises Bryant's explanation of Psyche as the symbol of the soul; and the same lines from Lucretius are quoted, and again very freely translated. In the following canto[3] of the same poem Eros and Dione appear as Sentimental Love

(1) Ibid., p.317.
(2) T.N. II. ll. 221-261; l. 223.n; and l. 261.n.
(3) T.N. III. ll. 177-206; l. 178.n.; and l. 181.n.

and Ideal Beauty, two concepts which are closely involved in Darwin's own associationist theory of psychology. Again, four lines from the opening passage of De Rerum Natura are quoted and again translated. It is noticeable, however, that in his treatment of this myth, which is assimilated more closely than usual into the main body of the verse, and into the substance of the thought there is no stress on the hieroglyphic significance of the picture on the original gem, no reference to the lost learning of ancient Egypt. This might, indeed, have overloaded an already heavily charged symbolism.

Darwin is thus able to take from Bryant what serves his purpose as scientist and poet, and to disregard the interpretation which Bryant places upon the material. Indeed, he selects from every writer those facts or illustrations useful to his theories, and ignores everything else. One feels, moreover, that very often his chief concern with mythology was the opportunities it offered for the creation of pictures in words. But since his aim, as a scientist, was to interest his readers in theories, he found in mythology, a subject of widespread interest and speculation, a means of strengthening the somewhat tenuous connections between the scientific and the decorative parts of the poetry. Egyptian chemistry was a fascinating subject for speculation; but the classical images provided by the fables were the conventional stuff of poetry. The work of the mythologists provided a convenient link between the pictures which sprang from the gems of antiquity and Wedgwood's reproductions of them, and the advanced scientific views which formed the main themes of the poem. Darwin's ingenuity, too, enabled him to give a new and very topical twist to the interpretation of myth; and since the modern chemistry was as yet "unexplored poetic ground,"[1] there was complete scope for originality.

He does, however, make extensive use of the historical mode of interpretation. Here he is conventional. He follows Danet's _Dictionary_, and the tradition exemplified in the Abbé Banier's edition of Ovid's _Metamorphoses_. Several examples can be found in _The Loves of the Plants_. And it is indeed noticeable that in his first poem, Darwin's treatment of mythology is practically restricted to historical explanation, with only one or two personal conjectures. Perhaps it was the approval with which his conjectures were greeted by Anne Seward and others, which led him, in his second poem, to explore new territory. And _The Economy of Vegetation_ offered the ideal opportunity.

---

(1) Anna Seward. _Memoirs of the Life of Dr.Darwin_. 1804. p.130.

THE PHYSIOLOGY OF PLANTS

Plant physiology, the nominal subject of The Economy of Vegetation, is expounded in a series of Additional Notes attached to brief references to the subject in the verse of the fourth canto of the poem. The major part of the canto is devoted to meteorology, the discoveries of Joseph Priestley, and topics arising out of these, and to practical instruction on the cultivation of fruit trees, plant diseases and the depredations of insects on plants, together with much poetical ornament. Although plant physiology occupies little space in the verse, however, the Notes are comprehensive, and contain a complete theory of the subject. Their contents were later incorporated in Darwin's prose work on agriculture and gardening, the Phytologia, where they more properly belong. Nevertheless, the verse references are not fully intelligible without some understanding of the theories behind them; and the Notes are of interest in themselves, both as a reflection of the contemporary state of botanical knowledge, and as an illustration of the manner in which Darwin could adopt existing knowledge to his own purposes.

At the time when Darwin was writing, the physiology of plants was still a matter for conjecture, rather than of established fact. Scientific investigation of plant anatomy had been encouraged in the previous century by the steady improvement of the microscope, and Robert Hooke, whose Micrographia was published in 1665, had observed among other things the cellular structure of plant tissues. He had suggested that there must be a passage of vegetable juices through the walls of the "cells". He was the first to use the word in this sense. During the same decade, investigation of plant structure was being carried on independently by Marcello Malpighi in Italy and by Nehemiah Grew in England. Both men belonged to the medical profession, and it was their knowledge of animal anatomy that led them to the study of phytonomy; and both were concerned with the general structure of plants, rather than with minute investigation of plant tissues. Malpighi laid his results before the Royal Society, of which he was a member, in 1674. Grew published his complete works, under the title The Anatomy of Plants, in 1682. The result of their researches was an explanation of the main structure of root and stem. They differentiated between rind, bast, wood and pith; described the longitudinal vessels of the woods with their spiral thickenings; discovered the stomata; and, finally, made certain conjectures concerning plant physiology.

Their investigations, together with those of Hooke, suggested that there was a movement of sap in the "tubes" of the plant. Harvey's discovery of the circulation of the blood in animal bodies had encouraged botanists to look for a similar process in plants, and a theory of sap circulation had been put forward as early as 1665. Malpighi's view was that the sap was drawn up from the root to the leaves, was there elaborated, and was then returned down the stem for purposes of nutrition. He did not suggest a complete circulation, although the idea was later attributed to him. A complete theory of plant nutrition, moreover, was not possible until chemistry had made further progress. Nor was the nature of plant respiration understood, although Grew correctly supposed the leaves to be respiratory organs. The most important of Grew's contributions was his theory that flowers are the sexual organs of plants. This was taken up and demonstrated experimentally by Jacob Camerarius in 1691. Malpighi, however, denied plant sexuality, and it was not until the works of Linnaeus became widely known, in the middle of the following century, that the theory became generally accepted.

The researches of Malpighi and Grew formed the basis of all future work, and when Darwin published his _Economy of Vegetation_ in 1791, he referred his readers to plates in Grew's _Anatomy of Plants_, which was still a standard work.[1]

---

(1) E.V. Add. Note XXXVI. p.99.

His theory of plant physiology owes much to their discoveries and to those of later botanists; but it also includes much that is his own. He had obviously devoted some attention to the subject. Experiments performed by him and quoted in the Additional Notes are dated from June to October, 1781.[1] And in the Advertisement to the first edition of The Loves of The Plants he explains that the publication of the first part of the poem has been deferred, in order that he may repeat some experiments on vegetation which are mentioned in the notes. The Phytologia, moreover, shows a development and elaboration of earlier theory, so that his interest did not cease with the publication of the poem.

To a knowledge of plant structure derived from earlier botanists Darwin was able to add the new chemical knowledge of his own period. Thus the Additional Note on plant perspiration,[2] which is placed with the rest of the series on physiology, is actually attached to lines occurring at the beginning of the fourth canto, and is strictly concerned with a hypothetical chemical reaction between water and light. Darwin had read Stephen Hales's account of transpiration, given in the Vegetable Staticks, published in 1727. Hales had shown that plants give off water from the leaves. It had

---

(1) E.V. Add. Note XXXVII. p.102. Add. Note XXXV. p.97.
(2) E.V. Add. Note XXXIV. on E.V. IV 1. 34.

since been demonstrated that plants exhale oxygen in sunlight, and this, it was commonly thought, was the product of respiration, which was therefore a process different from animal respiration. Darwin, anxious to preserve a strict analogy between plants and animals, explained the oxygen as the result of a decomposition by light of the water evolved in transpiration. He thus combined two processes under the title Vegetable Perspiration. This left carbon-dioxide, also known to be exhaled by plants, as the product of respiration, and the analogy remained unimpaired. There was no experimental evidence for the theory, but the idea was ingenious, and, it seems, sufficiently plausible in its own day.

The main body of the physiological theory, less directly chemical, belongs to the following lines:

> "Come, YE SOFT SYLPHS! who sport on Latian land,
> Come, sweet-lip'd Zephyr, and Favonius bland!
> Teach the fine SEED, instinct with life, to shoot
> On Earth's cold bosom its descending root;
> With Pith elastic stretch its rising stem,
> Part the twin Lobes, expand the throbbing Gem;
> Clasp in your airy arms the aspiring Plume,
> Fan with your balmy breath its kindling bloom,
> Each widening scale and bursting film unfold,
> Swell the green cup, and tint the flower with gold;
> While in bright veins the silvery Sap ascends,
> And refluent blood in milky eddies bends;
> While, spread in air, the leaves respiring play,
> Or drink the golden quintessence of day."[1]

---

(1) E.V. IV. 11. 409-422.

To this passage we attached Additional Notes entitled Vegetable Placentation, Vegetable Circulation, and Vegetable Respiration.[1] Darwin's theories of all these processes are founded on the assumption, stated in an earlier Additional Note on buds and bulbs, that

> "A TREE is properly speaking a family or swarm of buds, each bud being an individual plant, ... each bud has a leaf, which is its lungs, appropriated to it, and the bark of the tree is a congeries of the roots of these individual buds...."[2]

The word "plant" may be substituted here for "TREE", since the theory extends to all seed-bearing plants. Darwin adds that buds may be considered as the viviparous, seeds as the oviparous, offspring of plants. The obvious fact that the bud contains the rudiments of the plant was well known, and no doubt suggested the idea of the individuality of vegetable buds. The conception of the bud as the viviparous offspring of the plant was also common. Darwin's direct source was probably Milne's Botanical Dictionary. Milne says;

> "Plants, considered in analogy to animals, may properly enough be reckoned both viviparous and oviparous. Seeds are the vegetable eggs; buds, living foetuses or infant plants, which renew the species as certainly as the seed.
>
> . . . .

(1) E.V. Add. Notes XXXV, XXXVI, XXXVII.
(2) E.V. Add. Note XIV. p.27.

As each bud contains the rudiments of a plant, and would, if separated from its parent vegetable, become every way similar to it; Linnaeus, to shew the wondrous fertility of nature, has made a calculation by which it appears, that in a trunk scarce exceeding a span in breadth, ten thousand buds (that is, herbs) may be produced. What an infinite number then of plants might be produced from a very large tree!"[1]

An individual bud, or the leaf to which it gives rise, may thus be considered, according to Darwin, as an animal. Since this is so, he is able to say that although plants, immovably fixed to the soil, necessarily differ in some respects from animals, we must nevertheless expect to find some circulatory system comparable to that of the animal system. This will show the following features:

"1. A system of absorbent vessels to imbibe the moisture of the earth similar to the lacteal vessels, as in the roots of plants; and another system of absorbents similar to the lymphatics of animal bodies, opening its mouths on the internal cells and external surfaces of vegetables; and a third system of absorbent vessels correspondent with those of the placentation of the animal foetus. 2. A pulmonary system correspondent to the lungs and gills of quadrupeds and fish, by which the fluid absorbed by the lacteals and lymphatics may be exposed to the influence of the air, this is done by the green leaves of plants, those in air resembling lungs, and those in water resembling gills; and by the petals of flowers. 3. Arterial systems to convey the fluid thus elaborated to the various glands of the vegetable for the purposes of its growth, nutrition, and various secretions."[2]

---

(1) Colin Milne. A Botanical Dictionary. 1770. Art. Gemma.
(2) E.V. Add. Note XXXVI. p.98.

The absorbent vessels, according to Darwin, are the spiral vessels of the wood, described by Malpighi and Grew. Those belonging to each leaf unite in its footstalk to form a pulmonary artery, which branches out to the extremities of the leaf. Here the "vegetable blood", containing nourishment supplied by the absorbent vessels, is exposed to the air. It then passes into veins, which return on the under side of the leaf to a central vein. This passes into the footstalk, where it becomes an artery, conducting blood over the stem of the plant. There is thus a complete circulation in the leaf. But Darwin says quite clearly;

> ".... I imagine there is no venous system, no veins properly so called, which receive the blood which was to spare, and return it into the pulmonary or arterial system."[1]

This theory is supported by an account of experiments demonstrating the absorption of coloured fluids by the absorbent vessels and arteries of stems and leaves. These experiments were probably suggested by similar ones described by the Swiss scientist Charles Bonnet [2]. In actual fact they proved nothing. Darwin, however, concludes that there is a complete circulation in the leaf, though not in the rest of the vegetable system; plant circulation may therefore be compared to that of fish. He adds;

---

(1) Ibid., p.100.
(2) Recherches sur l'usage des feuilles dans les plantes et sur quelques autres sujets relatifs à l'histoire de la végétation. 1754. cf. E.V. Add. Note. XXXVII. p.102.

> "At the same time so minute are the vessels in the intertexture of the barks of plants, which belong to each individual bud, that a general circulation may possibly exist, though we have not yet been able to discover the venous part of it."[1]

By 1800, Darwin had convinced himself that this general circulation did exist, and in the <u>Phytologia</u> his theory is accordingly elaborated.[2] The analogy between plants and animals is thus in the later work even closer. In actual fact, little was known of the subject. There was no conclusive evidence against such a theory, and good precedent for it. Early volumes of the <u>Philosophical Transactions</u> show a steadily growing tendency to equate the vital processes of plants with those of animals; and in the seventh edition of Miller's <u>Gardeners Dictionary</u>, a standard authority, issued in 1759, we find;

> "Botanists are now generally agreed, that all Plants are furnished with Organs and Parts necessary both for Chylification and Sanguification, that they have Veins, Arteries, Heart, Lungs, adipose Cellules, &c."[3]

Although Linnaeus had denied sap circulation, the whole question was still undecided late in the century, as is shown by a paper read before the Royal Society of Edinburgh by John Walker in 1783.[4] One extreme of opinion was represented by Richard Bradley, author of a well-known work on gardening, who declared that

---

(1) E.V. Add. Note XXXVI. p.100.
(2) <u>Phytologia</u>. Part I. Sect. V.1.
(3) <u>Philip Miller</u>. <u>The Gardeners Dictionary</u> 1731-39, 7th ed. 1759. Art. Sap.
(4) John Walker. <u>Experiments on the Motion of Sap in Trees</u>. <u>Transactions of the Royal Society of Edinburgh</u>. 1788. Vol.I. Part II. I. (1) p.3.

"....the Juices in Plants have a Motion throughout the whole Plant, or circulate about it as the Blood does in the Bodies of Animals, and not up and down only in streight lines, as has been suppos'd by several Gardeners."[1]

The other extreme was represented by Stephen Hales, who concluded from his investigations of transpiration that there was no such circulation. Darwin appears to be the only exponent of a circulation complete in the leaf but not in other parts of the plant, and his theory may possibly have been suggested by John Walker's paper, referred to above. Walker had said that there seems to be no circulation in trees before the leaves appear, but that there was no evidence to disprove circulation at other times. At any rate, Darwin's application of the terminology of animal anatomy to phytonomy is nothing new; though he does it a little more thoroughly than anyone else. His anxiety to show that animals and plants are of one kind is presumably due to his theory of evolution, expounded in the _Zoonomia_ and _The Temple of Nature_.[2] If all living organisms were descended from one original filament endowed with life by the Great First Cause, they should show basic similarity of structure. The analogy is preserved even more strictly in Darwin's treatment of Vegetable Placentation. Not only does

---

(1) Richard Bradley. _A General Treatise of Husbandry and Gardening_. 1726. Vol.I. p.281.
(2) See below, _The Production of Life_.

each leaf have its own absorbent, arterial and venous system. The bud in the axil of the leaf is the viviparous offspring of the leaf, and must therefore be furnished with placental vessels for its nourishment. He explains that during the summer, food is stored in the roots and stems of the plant. When the spring comes and the sap begins to rise, it is carried up the vessels of the sap-wood and supplied to the new buds, which have as yet no absorbent or respiratory system of their own. The vessels of the previous year's sap-wood thus act as "umbilical cords" to the new buds.

> "Nor need we wonder at the length of the umbilical cords of buds since that must correspond with their situation on the tree, in the same manner as their lymphatics and arteries are proportionately elongated."[1]

The bud, supplied with nutriment in this manner, shoots down roots, which cover the old bark of the tree; and as soon as these new roots become capable of absorbing juices from the earth, and the new leaves, with their respiratory system, are developed, the placental vessels cease to act, coalesce, and become converted into inert wood, serving only for the support of the new tree. This theory, extraordinary as it is, derives something from the opinion expressed by Malpighi and Grew, that the solid "wood" of the

---

(1) E.V. Add. Note XXXV. p.97.

tree develops from the living sap-vessels. The real distinction between wood, or xylem, and bast, or phloem, and the existence of a growing layer between them was not suspected at this time. Explanation of the new sap-vessels as the "roots" of buds, however, seems to have been Darwin's own idea. In the Phytologia he improves upon the whole theory, and informs his readers that the umbilical vessels are formed in the bark about midsummer, and are therefore a separate organisation from the absorbent system of the parent leaf. Each umbilical vessel is now attended by an artery, which is in contact with the lateral air vessels which penetrate the bark of trees horizontally, and which provides for the oxygenation of the blood supplied to the embryon.[1]

The Additional Note on plant respiration develops the theory of a circulation in the leaf or "lung" a little more fully. Here Darwin also explains that there is another pulmonary system, independent of the green foliage, in the corol or petals. The petals serve as lungs to the parts of fructification in the same way as the leaves serve the rest of the plant. He thus passes from accepted theory to personal hypothesis. He was, in fact, expounding in these Notes a new and boldly conjectural theory of plant physiology.

---

(1) Phytologia. Part I. Sect.I.7 and Sect.III.II.6 and 7.

Unfortunately, the reader who confined his attention to the poem and neglected the prose additions would not suspect its existence, since the three lines of verse to which it is all attached suggest only the most general outline of conventional botanical teaching. And the overbalance of Notes is much too great, even for a scientific poem. The reader would hardly be tempted to investigate them.

The production of the bud in the axil of the leaf, introduced into a passage of verse on the cultivation of fruit trees, is accounted for by the explanation given by Linnaeus:

> "The calyx of a flower, he says, is an expansion of the outer bark, the petals proceed from the inner bark or rind, the stamens from the alburnum or woody circle, and the style from the pith".[1]

In verse this becomes;

> "Closed in the Style the tender pith shall end,
> The lengthening Wood in circling Stamens bend;
> The smoother Rind its soft embroidery spread
> In vaulted Petals o'er their fertile bed;
> While the rough Bark, in circling mazes roll'd,
> Forms the green Cup with many a wrinkled fold;"[2]

This is perfectly orthodox. Linnaeus's theory of the production of the flower, however, seems to have been at least a contributory source of what is, perhaps, to the modern mind, the most extravagent of all Darwin's conjectures, the derivation of insects from the parts of fructification of plants.

---

(1) E.V.Add.N. XXXVIII. p.107. cf. The System of Vegetables. Translated.... by a Society at Lichfield. 1783. p.9.
(2) E.V. IV. 11. 469-74.

This is not stated in verse. It is hidden away in an Additional Note,[1] and modestly attributed to a philosopher of Darwin's acquaintance. The route by which he arrives at the conclusion is tortuous. First, he describes in verse the sexual reproduction of plants. The Sylphs are directed to

> "Bid the closed <u>Petals</u> from nocturnal cold
> The virgin <u>Style</u> in silken curtains fold,
> Shake into viewless air the morning dews,
> And wave in light their iridescent hues;
> While from on high the bursting Anthers trust
> To the mild breezes their prolific dust;
> Or bend in rapture o'er the central Fair,
> Love out their hour, and leave their lives in air.
> So in his silken sepulchre the Worm,
> Warm'd with new life, unfolds his larva form;
> Erewhile aloft in wanton circles moves,
> And woos on Hymen-wings his velvet loves".[2]

The imagery would seem to come directly from the <u>Philosophia Botanica</u> of Linnaeus:

> "The <u>calyx</u> then is the marriage bed, in which the <u>stamina</u> and the <u>pistilla</u>, the male and the female organs, celebrate the nuptials of plants;...... The <u>corolla</u>, or petals are the curtains,...."[3]

The insect, too, may have been suggested by Linnaeus, who speaks in the <u>Systema Vegetabilium</u> of "the mystery of the Metamorphosis of Plants, in which the <u>Larva</u> of the herb is changed into a <u>Displayed</u> Fructification."[4] He explains that "the unclad Larva of the Herb" comes forth from the plant like a flying insect from its chrysalis, "<u>Wing sheathed</u> in respect to the Calyx, <u>Winged</u> in respect to the Corol, consisting alone of the Organs of Reproduction."[5]

---

(1) Add. Note XXXIX. p.109.
(2) E.V. IV. 11. 449-60.
(3) Translated as <u>The Elements of Botany</u>. Hugh Rose. 1775. p.219.
(4) <u>The System of Vegetables</u>. 1783. p.9.
(5) Ibid., p.10. cf. E.V. Add. Note XXXVIII. pp.106-7.

This translation is quoted from the version of 1783 produced by the Botanical Society of Lichfield, and may be from Darwin's pen. It must be noticed, however, that the insect is mentioned by Linnaeus as a figure of speech only. He employs the same image in A Dissertation on the Sexes of Plants, first published in 1760, and translated into English in 1786.[1] He remarks;

> "The evolution of flowers is exactly similar to the exit of insects from their caterpillars;"[2]

and again;

> "Thus vegetables like insects, are subject to a metamorphosis; with this difference only, that their flowers are fixed to one spot, instead of being able, like insects, to fly from place to place; and that their nourishment is not given them by means of peculiar organs for the formation of chyle."[3]

These comments are probably sufficient to have stimulated the exercise of Darwin's characteristic ingenuity. In the Additional Notes, however, he approaches the subject cautiously. That entitled Vegetable Impregnation is concerned with the part played in reproduction by the pollen grain, and he discusses, without committing himself to either, each of the two popular theories. The first of these was that the pollen, or male fluid generally, acts only as a stimulus upon the egg, which contains the whole embryo before impregnation. The other was that the sperm,

---

(1) A Dissertation on the Sexes of Plants. James Edward Smith, 1786.
(2) Smith, op.cit., p.20.
(3) Ibid., p.22.

or pollen grain, unites with the ovum to form the embryo. The following Note, Vegetable Glandulation, is more directly concerned with the reproductive organs of plants. Here he suggests that the use of honey is for the nourishment of the stamens and pistils. These parts of the flower therefore resemble moths and butterflies, which also feed on honey. And so, if he is correct in attributing this function to the nectary, the anthers and stigmas

> "become in reality insects fed with honey, similar in every respect except their being attached to the tree on which they were produced."[1]

From here it is but a step to the final conjecture:

> "I am acquainted with a philosopher, who contemplating this subject thinks it not impossible, that the first insects were the anthers or stigmas of flowers; which had by some means loosened themselves from their parent plant, like the male flowers of Vallisneria;[2] and that many other insects have gradually in long process of time been formed from these; some acquiring wings, others fins, and others claws, from their ceaseless efforts to procure their food, or to secure themselves from injury. He contends, that none of these changes are more incomprehensible than the transformation of tadpoles into frogs, and caterpillars into butterflies."[3]

Here is stated, quite clearly, the evolutionary theory which Darwin develops in more detail in his later works.

The use of the nectary was a disputed point among botanists. Darwin's conclusion that it serves to nourish the flower parts leads him to suppose that the depredations

---

(1) E.V. Add. Note XXXIX. p.109
(2) See L.P. I. 11. 393-406 and 1.395.n.
(3) E.V. Add. Note XXXIX. p.109.

of insects upon the honey are harmful to the plant, and he assumes that plants

> "have either acquired means to defend their honey in part, or have learned to make more than is absolutely necessary for their own economy."[1]

So he adds:

> "To prevent the depredation of insects on honey, a wealthy man in Italy is said to have poisoned his neighbour's bees perhaps by mixing arsenic with honey, against which there is a most flowery declamation in Quintilian."[2]

This story from Quintilian had been related by Linnaeus in the Philosophia Botanica. But Linnaeus had concluded the anecdote with the following comment:

> "But after all, my opinion is, that the bees are more useful than hurtful to flowers, since by their unwearied labours they spread the fertilizing dust, so that it may reach the pistillum; for it is not clear what use the honey juice is of in the economy of flowers."[3]

It is unlikely that Darwin did not know that bees could bring about cross-fertilisation, since Bradley's General Treatise on Husbandry and Gardening contains a letter from Philip Miller, describing his famous experiment with tulips.[4] Miller had removed the anthers of some tulips, in order to prevent impregnation, and had then observed bees carrying pollen from other tulips and depositing it in the stigmas of the castrated flowers as they collected the nectar.

---

(1) Ibid., p.110.
(2) Ibid., p.110.
(3) Rose, op.cit., p.217.
(4) Bradley, op.cit., Vol.I. p.330.

Bradley, commenting upon Miller's account, had said that impregnation by insects "is a thought entirely new,"[1] and had also remarked that

> ". . . we must consider, that these castrated Flowers were not void of that excellent Dew from whence they [the bees] extract their Honey;"[2]

It is perhaps strange that Darwin had not taken up the point. He evidently knew little of the work of Joseph Koelreuter, who had shown, in 1760, that insects were frequently the agents by which cross-pollination was effected, although he refers, in a quotation from Blumerbach, to Koelreuter's experiments on hybrids, in the Phytologia.[3] Nor, apparently, did he later come to hear of the conclusions of Christian Sprengel, who in 1793 suggested that the nectar is intended to attract insects, and showed that the structure of flowers could be explained on the principle of their relation to insects.

The Additional Note on glandulation concludes Darwin's exposition of plant physiology. On one topic he has said little. The footnotes to The Loves of the Plants[4] contained his theory of plant sensitivity, and in the later poem there are only passing references to the irritability, sensibility and voluntary powers of vegetables. In the Phytologia, however, we find a section headed The Muscles, Nerves, and Brain of Vegetables,[5] and the analogy between plants and animals is thus completed.

---

(1) Ibid., p.333.
(2) Ibid., p.334.
(3) Phytologia. Part I. Section VII. 2. 6. (p.117).
(4) ~~See below,~~ The Loves of the Plants, p.269 ff.
(5) Part I. Sect.VIII.

THE LOVES OF THE PLANTS

The Loves of the Plants was published in 1789. Its author, possessed as he was of a lively fancy and a remarkable command of fashionable poetic language, could hardly have failed of success, for the poem was an ingenious and well-timed exploitation of one of the most popular pursuits of the day. The Linnaean system of botanic classification was, as Darwin remarked in 1777, "unexplored poetic ground."[1] It was both an entirely new subject for verse and a topic which commanded the interest of a wide reading public. If it had possibilities in 1777, by 1789 it met a public well prepared and eager to receive it, for the intervening years had seen a wide extension of interest in the whole subject of botany. The translations of two major works of Linnaeus, by the Botanical Society of Lichfield, probably had a share in this. These appeared in 1783 and 1787. In 1785 Thomas Martyn, Professor of Botany at Cambridge published an English version of Rousseau's *Letters on Botany*, a work which had been designed to promote the study of botany in France. In 1788 Martyn followed this up with *Thirty-Eight Plates, with Explanations; intended to illustrate Linnaeus's System of Vegetables*. The illustrations were done by Frederick Nodder,

---

(1) Anna Seward. *Memoirs of the Life of Dr.Darwin*. 1804. p.130.

"Botanical Painter to her Majesty", who later provided the illustrations for The Loves of the Plants. In the same year James Edward Smith, who in 1784 had purchased and conveyed to England Linnaeus's herbarium and library, founded the Linnaean Society, for the encouragement of botanical and zoological studies. About this time Richard Pulteney was evidently feeling that the time was ripe for an historical review of botanical studies, for in 1790 he published Historical and Biographical Sketches of the Progress of Botany in England from its origin to the introduction of the Linnaean system. The publication of such a work indicates the interest and importance attached to the subject.

The introduction of the Linnaean system had been a turning point in botanical studies. At the time of the Renaissance botany had emerged as a subordinate branch of the study of medicine. Inquiry was stimulated by geographical exploration and extension of commerce, and the immediate result was the production of the herbals of the sixteenth century. This led to investigation of native flora, and attempts to classify the plants examined. In the later part of the seventeenth century Robert Morison, first occupant of the Chair of Botany at Oxford introduced into England a system of classification based on the parts of fructification of the flower. The system had been devised by the Italian scientist Cesalpino in the previous century, and its basic principles were later adopted by Linnaeus. About the same time John Ray was working out another classification, based on all the principal parts of the plant. This was the first comprehensive "natural" classification to appear in England, and it enjoyed a great vogue until the introduction of the Linnaean system in the 1750's. Practical interest in the subject manifested itself in the foundation of botanic gardens. The Botanic Garden at Oxford was started in 1621. It was followed by the Royal Garden at Edinburgh in 1667, and the Physic Garden of the Society of Apothecaries at Chelsea in 1673. During the following century the garden of Kew House was developed by Sir Joseph Banks, acting for George III, and became the most famous of all. Thus the ground was well-prepared for Linnaeus, though the triumph of his system of classification was in itself a remarkable phenomenon. Its advantages were its order and simplicity. The method "enabled anyone who could count up to twenty to place a plant at a glance in its appropriate niche."[1] It was essentially an artificial system, being based on the number and position of stamens and stigmas in the flower, and Linnaeus himself regarded it as a temporary expedient,

---

(1) John Gilmour. British Botanists. [Britain in Pictures.] 1944. p.30.

which should serve until a satisfactory natural system could be worked out. What happened was that it proved so convenient, so easy to handle, that existing natural classifications, including that of Ray, fell into disuse, no attempts were made to replace them, and the progress of botany was stultified for half a century. In 1754 translations of Linnaeus's works began to appear in England. In 1760 the Fundamenta Botanica, which contains the elements of the botanic classification, was published in English, and about the same time Martyn began to teach the Linnaean system at Cambridge. From this time there was a steady growth of interest in the subject, and a gradual diffusion of knowledge of Linnaeus's works.

The circles in which Darwin moved were not behind the times. The Botanic Society of Lichfield is itself an indication of the general tendency, though it found few active supporters. Darwin's botanic garden, which he "gave to beauty, and intended giving to science"[1] was a product of its age. It was more than rivalled by that of John Saville, Vicar-choral of Lichfield Cathedral, of whom Anna Seward wrote in 1788:

---

(1) Letters of Anna Seward: written between the years 1784 and 1807. 1811. Vol.II. p.278.

> "Mr.S. is engrossed by attendance upon at least two thousand rare plants and flowers, so that his friends lose many hours every week of his company; - hours which they do not like to spare. But his fame as a botanic florist lies far. On the side of Johnson's favourite gigantic willow, and in the bosom of that pretty valley which slopes from the east end of our cathedral, lies his little garden. It is become one of the Lichfield lions which strangers go to see."[1]

Miss Seward herself knew little of botanical science. Mrs.French, however, whose death was lamented in The Economy of Vegetation,[2] was an enthusiastic botanist. Dr. Withering, Birmingham physician and member of the Lunar Society, had published in 1776 A Botanical Arrangement of all the Vegetables naturally growing in Great Britain, which was based on the Linnaean system; and the preparation of subsequent editions of this work was his life-long occupation. Darwin was thus not alone in his botanic labours. Indeed, his brother, Robert Waring Darwin of Elston, published in 1787 a work entitled Principia Botanica. A third edition was issued in 1810 and dedicated to the author's namesake, Erasmus Darwin's third son. This edition contains numerous quotations from and references to The Botanic Garden.[3] The two brothers may have co-operated to some extent. At any rate, one of the Addition Notes[4] to

---

(1) Ibid., p.180.
(2) E.V.III. 11.297-320, and lines omitted, p.212.
(3) See Robert Waring Darwin (the elder) Principia Botanica: Or, a concise and easy introduction to the Sexual Botany of Linnaeus. 1787 (3rd ed. 1810, pp.48, 76, 109, 305, etc).
(4) L.P. Add. Notes, p.181 (note to p.15.)

The Loves of the Plants contains a letter written by R.W. Darwin the elder, to his brother, in 1788, describing the activities of a certain fly-catching plant. The Principia Botanica: Or, a concise and easy introduction to the Sexual Botany of Linnaeus is based on the Linnaean system. In it Robert Darwin adopts the English version of the Linnaean terminology which had been used in the Lichfield Society's System of Vegetables, and which was again used in The Families of Plants. The second of these two works places the Principia Botanica in a list of recent and useful works on botany which ~~we~~ are recommended to the reader.[1] Robert Darwin, indeed, may have had a hand in working out the terminology.

The work of translation was undoubtedly a useful preparation for The Loves of the Plants. One of Darwin's preliminary attempts to find English equivalents of the Linnaean terms has survived in the Commonplace Book preserved at Down House. There we find the comment

> "Linnaeus might certainly be translated in English without losing his sexual terms, or other metaphors, and yet avoiding any indecent idea."[2]

There follows a list of possible words, including lords, masters, male coquettes, viragoes, lady, wife, belle,

---

(1) C.Linnaeus. The Families of Plants. Translated.... By a Botanical Society at Lichfield. 1787. Preface of the Translators. Vol.I. p.xviii.
(2) Commonplace Book, p.72.

and others, some of which, although not used in the translation, found their way into the poem. In the translator's Preface to The System of Vegetables the difficulty involved in the formation of an English botanic terminology based on the Latin is explained at some length, for this was the first English translation of the detailed classification, although versions of the more general works had appeared previously. Withering's Botanical Arrangement is sternly criticised for its failure to include "the sexual distinctions, which are essential to the philosophy of the system";[1] although Withering had translated parts of the Genera and Species Plantarum of Linnaeus. The translator's remark;

> "We were afraid of rendering our work difficult to the english reader, if we introduced many innovations, or did much violence to our vernacular tongue; or of making it unintelligible to the latin Botanist, if we were too parsimonious in the engraftment or transplantation of exotic terms. We hope we have steered between these two extremes, for we have had the opinion of many and skilful pilots to direct our voyage; the celebrated Mr.ROSSEAU(sic),in a Posthumous Botanical work had adopted a similar plan; and has attempted to naturalise into the french language many of the technical words of Linneus;...."[2]

---

(1) The System of Vegetables, translated... by a Society at Lichfield. 1783. Preface of the Translators, p.ii.
(2) Ibid., p.iv.

The acknowledgements at the end of the Preface include one to "that great Master of the english tongue, Dr.SAMUEL JOHNSON, for his advice in the formation of the botanic language";[1] so that the translation had authority behind it. It was hoped that the work would make available to all "that System which hitherto like the Bible in catholic countries, has been locked up in a foreign language, accessible only to the learned few, the Priests of Flora",...[2]

The actual terminology which was evolved was basically that which was later adapted for The Loves of the Plants. Linnaeus had divided plants into twenty-four classes. The first eleven of these are distinguished simply by the number of stamens in each flower. Thus the first class, Monandria, consists of plants which have one stamen, the second, Diandria, of plants which have two stamens, and so on up to ten. The eleventh class has twelve stamens, the twelfth class, Icosandria, has twenty stamens, which are at the same time inserted on the calyx, and the thirteenth class from twenty to a hundred stamens not adhering to the calyx. In the translation these are rendered One Male, Two Males and so on up to ten. The twelfth class is called Twenty Males, and the thirteenth, Polyandria, Many Males. The

(1) Ibid., p.xi.
(2) Ibid., p.xi.

fourteenth class of Linnaeus, consisting of plants with four stamens, two of which are taller than the other two, and the fifteenth class, consisting of plants with six stamens, four of them superior, are called respectively Two Powers and Four Powers. The next four classes, differentiated by adhesion of the stamens to one another, are Monadelphia, in which many stamens are united by their filaments, Diadelphia, in which many stamens are united in the same way, but in two separate groups or companies, Polyadelphia, in which they are united into three or more groups, and Syngenesia, in which there are many stamens united by their anthers. These were rendered One Brotherhood, Two Brotherhoods, Many Brotherhoods and Confederate Males. The twentieth class, Gynandria, consisting of flowers in which many stamens are united to the pistil, was called Feminine Males. All these plants, in which both stamens and pistils are found were termed, following Linnaeus, Hermaphrodite flowers, and their conjunction, Marriages of Plants. The next three classes contain those plants whose flowers are of one sex only. In Monoecia, the male and female flowers are separate, but are found on the same plant. In Dioecia the male and female flowers are on separate plants. And Polygamia consists of plants where male and female flowers are separate, on either the same or different plants, but where hermaphrodite flowers are found in addition. The names given to these were One House, Two Houses, and Polygamy. The last class, Cryptogramia, contains plants whose flowers are not discernible, and was called Clandestine Marriage. Thus the whole scheme of The Loves of the Plants lay ready to hand. The System itself provided the framework of the poem; and the sexual terminology lent itself admirably to personification. The professed object of the poem was to explain the Linnaean classification, together with "the remarkable properties of many particular plants";[1] and where the botanical facts were obscured in the poetical expression, the notes could be used to convey necessary information.

Before the poem reached its final state, it was sent in manuscript to James Keir, who read it, showed it to his family, and returned it with a letter, dated September 1st, 1787, in which he made several suggestions. Keir said, after preliminary praise;

> "I can have no doubt that the poem will please both the reader and the bookseller, and also the author, whenever you publish it; and as you desire my opinion on the propriety of publishing, I do not only give it as above, but also the reasons on which I ground my opinion, that you may not suppose it given as a customary courtesy between an author and his friends. The sale will probably not be so great at first, as it will be lasting and increasing; and this, I conjecture, from the subject of Botany not being understood generally

(1) E.V. Advertisement. p.[V]

> sufficiently to make people relish it. I think great advantage in this respect might be derived from prefacing a very short introduction, in which you will explain in the easiest manner possible as much of Linnaeus's system as is sufficient for understanding the poem and the notes, and no more than is sufficient and necessary; and for the greater facility for giving this first idea to persons ignorant of Botany, I would advise a print, by way of vignette to the introduction, of some flower, the fittest for your purpose. You might also prefix and post-fix vignettes to each part of the poem, representing some of the principal plants mentioned, for the benefit of many readers who do not know them. Your readers will not be confined to botanists, but I doubt not many of them may be enticed by the poem to become botanists; and as this is your express intention, to promote the study of botany, you ought to do everything you can to facilitate the admission of the first ideas of it."[1]

The evident result of this is the Preface to the poem, in which the outline of the Linnaean scheme is given. This is illustrated by a plate "from the Dictionaire Botanique of M.Bulliard",[2] which provides a picture of the flower-parts of one specimen of each of the twenty-four classes. In the original, the drawings are coloured, and are therefore rather clearer than they appear in Darwin's work. Keir's advice is further followed in the inclusion of plates of some of the more remarkable plants. And the whole is adorned by a frontispiece designed by Emma Crewe. The volume was thus an impressive production.

---

(1) A.Moilliet. Sketch of the Life of James Keir, Esq., F.R.S., with a selection from his correspondence. Edited by Alexander Blair and printed for private circulation. 1859. p.79.

(2) Pierre Bulliard. Dictionnaire Élémentaire de Botanique. Paris. 1783. Plate II (facing page 116).

The explanatory Preface and plate are followed by a Proem addressed to the reader, in which Darwin explains that whereas Ovid turned men and women into plants,

> "I have undertaken by similar art to restore some of them to their original animality, after having remained prisoners so long in their respective vegetable mansions; and have here exhibited them before thee. Which thou may'st contemplate as diverse little pictures suspended over the chimney of a Lady's dressing-room, connected only by a slight festoon of ribbons. And which, though thou may'st not be acquainted with the originals, may amuse thee by the beauty of their persons, their graceful attitudes, or the brilliancy of their dress."[1]

When Darwin speaks of "diverse little pictures" he is probably thinking of the sets of tablets in bas-relief designed by Wedgwood for insertion into chimney-pieces. The subjects were usually classical, but were not necessarily connected in theme. In a letter to Edgeworth written from Derby in 1790 Darwin explains that the Proem was added "to give a little air of burlesque to shelter myself under". "To 'the festoon of ribbon' in the preface", he adds, "I think you helped me".[2] This accounts for the italics in the passage quoted above.

The Proem thus clearly indicates that the poem is a light, even humorous composition, and that no sustained theme is to be sought in the verse. It is to be regarded as a collection of short poetical episodes, or pictures in

---

(1) L.P. Proem. p.(VIII)
(2) Memoirs of Richard Lovell Edgeworth, begun by himself and concluded by his daughter Maria Edgeworth. 1820 (3rd ed. 1844. p.326).

verse. And this is the plan Darwin follows, if indeed there is a plan. There is certainly an outline scheme. The first of the four cantos consists of short verse-paragraphs describing a wide variety of plants, English and foreign, according to the Linnaean classification. Some are evidently selected as illustrations of a particular botanical fact; some are probably chosen for their peculiar beauty of colour or form; a few seem to be introduced for the sake of the similes attached to them. They include wild flowers, garden flowers, grasses, trees, marine plants, Alpine plants, fungi and lichens, and do not appear to be arranged in any special order, apart from that based on sufficient contrast, variety or similarity. Thirty-eight plants are described altogether. In the second canto Darwin treats of only thirteen plants, but deals with each at much greater length. Five of these are plants useful to man, and the prevailing theme of the canto is man's struggle to achieve civilisation, though it has also a wide variety of subordinate and chiefly decorative descriptions and incidents. The third canto consists, like the first two, of a series of detached pictures, but it has more unity of tone. All the fourteen plants are either noxious, or have some idea of gloom or terror attached to them by Darwin. The fourth canto contains a variety of plants, twenty in all, linked by no dominant theme. The tone is light; there is much ornament and some humour, but as a whole the canto fails to add anything new or significant to the poem, and comes as something of an anti-climax after the sustained gloom of the previous section. The poem is put into the mouth of the Botanic Goddess, sometimes called the Botanic Muse, who addresses her discourse to the Sylphs and the Gnomes. The inhabitants of the other elements are not introduced.

The Botanic Muse is invoked thus:

> "BOTANIC MUSE! who in this latter age
> Led by your airy hand the Swedish sage,
> Bade his keen eye your secret haunts explore
> On dewy dell, high wood, and winding shore;
> Say on each leaf how tiny Graces dwell;
> How laugh the Pleasures in a blossom's bell
> How insect LOVES arise on cobweb wings,
> Aim their light shafts, and point their little stings."[1]

A footnote explains that

> "Linneus, the celebrated Swedish naturalist, has demonstrated, that all flowers contain families of males or females, or both; and on their marriages has constructed his invaluable system of Botany."[2]

This is not strictly true. It was Camerarius, not Linnaeus, who demonstrated the sexuality of plants; though Linnaeus undoubtedly did most to popularise the discovery. In 1759 the Imperial Academy at Petersburg offered a prize for the best dissertation submitted on the sexuality of

---

(1) L.P. I. ll.31-38.
(2) L.P. I. l.10, n.

plants. Linnaeus won it, not for an experimental proof, but for a scholastic demonstration of the necessary truth of the theory. His work was translated into English, under the title, A Dissertation on the Sexes of Plants, by James Edward Smith, in 1786, and would therefore, very probably, be fresh in Darwin's mind, and in the minds of his botanical readers.

The first plant to be described is Canna, or Indian Reed. Throughout the work the Latin generic names of the plants, according to Linnaeus, are used in the verse. The specific name and the popular English name are sometimes added in the notes.

"First the tall CANNA lifts his curled brow
Erect to heaven, and plights his nuptial vow;
The virtuous pair, in milder regions born,
Dread the rude blast of Autumn's icy morn;
Round the chill fair he folds his crimson vest,
And clasps the timorous beauty to his breast."[1]

A note informs the reader that "One male and one female inhabit each flower. It is brought from between the tropics to our hot-houses, and bears a beautiful crimson flower."[2]

Darwin thus begins with a plant of the first Linnaean Class. Canna belongs, moreover, to the first Order of the first Class. The Orders are explained in

---

(1) L.P. I. ll.39-44.
(2) L.P. I. l.39,n.

the Preface to the poem. The Orders of the first thirteen Classes are based on the number of females, or pistils in each flower, so that a plant with one male and one female belongs to the first Order of the first Class. In the other classes, except in Two Powers, Four Powers, Confederate Males and Clandestine Marriage, the Orders are based on the numbers of males in each flower. The Orders are thus easily represented in the personification, except in these four Classes. Here the Orders are distinguished by rather more complex structural features of the flower, and Darwin does not attempt to represent them in the verse.

Canna is a good illustration of Darwin's method of personification. Strictly speaking, only the stamens and stigmas are concerned with the sexual activities of the plants. By introducing the crimson petals of the flower as the "crimson vest" of the male, he is following a double scheme of personification. In practice this creates no difficulty; in fact the more general and more familiar personification helps the specifically sexual.

The second plant belongs to the second Order of the first Class:

> "Thy Love CALLITRICHE, two Virgins share,
> Smit with thy starry eye and radiant hair;"[1]

---

(1) L.P. I. 11.45-46.

The third illustrates the first Order of the second Class:

> "TWO brother swains, of COLLIN'S gentle name,
> The same their features, and their forms the same,
> With rival love for fair COLLINIA sigh,
> Knit the dark brow and roll the unsteady eye."[1]

Throughout the poem the number of the Class or Order, when introduced into the verse, is printed in italics. To each flower is attached a footnote explaining its position in the Linnaean classification, describing any noteworthy features or properties of the plant, and giving other observations or comments which Darwin considers relevant. There is no attempt to follow the numerical order of the Linnaean system. Occasionally, where the plant as a whole is of special interest, the Linnaean reference is omitted altogether. But in general, the personification is adapted to the classification with much ingenuity. The stamens may be described, according to the Class of the plant, as "four silvan youths", "five shepherds", "ten lofty bravoes", or "twenty priests"; the titles vary with the nature and form of the plant. The stigmas become "three blushing maids", "five sister-nymphs", or "two Harlot-Nymphs". Where the structure of the plant is more complex, the device is elaborated correspondingly. Thus Cupressus, which belongs to the Class One House, is described:

---

(1) L.P.I. 11.51-54.

"CUPRESSUS dark disdains his dusky bride,
<u>One</u> dome contains them, but <u>two</u> beds divide."[1]

This is followed immediately by

"The proud OSYRIS flies his angry fair,
<u>Two</u> houses hold the fashionable pair."[2]

Melissa belongs to the Class Two Powers, since it possesses four stamens, of which two are superior. In the verse this is expressed;

"<u>Two</u> knights before thy fragrant altar bend,
Adored MELISSA! and <u>two</u> squires attend."[3]

Curcuma is a special case. The flower has one male and one female; but in addition there are four filaments without anthers, which Linnaeus, as Darwin explains, called "eunuchs". Thus:

"Woo'd with long care, CURCUMA cold and shy
Meets her fond husband with averted eye;
<u>Four</u> beardless youths the obdurate beauty move
With soft attentions of Platonic love".[4]

Mimosa belongs to the Class Polygamy, and bears on one plant flowers containing males and females and also separate female flowers. Thus;

"Veil'd,with gay decency and modest pride,
Slow to the mosque she moves, an eastern bride;
There her soft vows unceasing love record,
Queen of the bright seraglio of her Lord."[5]

For the loves of the Cryptograms Darwin is content with "<u>secret</u> loves", or "<u>clandestine</u> rites."[6] When, however, he

---

(1) L.P. I. 11.73-74.
(2) L.P. I. 11.75-76.
(3) L.P. I. 11.59-60.
(4) L.P. I. 11. 65-68.
(5) L.P. I. 11.309-12.
(6) See. L.P. I. 11.427-30 and 11.93-96.

comes to the Class Feminine Males, the attempt to correlate botany and poetry ends in disaster. The plant he chooses is Kleinhovia;

> "Gigantic Nymph! the fair KLEINHOVIA reigns,
> The grace and terror of Orixa's plains;
> O'er her warm cheeks the blush of beauty swims,
> And nerves Herculean bend her sinewy limbs;
> With frolic eye she views the affrighted throng,
> And shakes the meadows, as she towers along,
> With playful violence displays her charms,
> And bears her trembling lovers in her arms."[1]

Sometimes a plant serves to introduce a work-picture which is included for its own sake, and not for its connection with botany. Thus Anthoxa, or Vernal Grass occasions a landscape painting:

> "TWO gentle shepherds and their sister-wives
> With thee, ANTHOXA! lead ambrosial lives;
> Where the wide heath in purple pride extends,
> And scatter'd furze its golden lustre blends,
> Closed in a green recess, unenvy'd lot!
> The blue smoak rises from their turf-built cot;
> Bosom'd in fragrance blush their infant train,
> Eye the warm sun, or drink the silver rain."[2]

Similarly Ulva, a sea-weed, who guides her "buoyant skiff" to "seek her Lord amid the trackless tides"[3] prefaces a purely ornamental picture, probably inspired by a Wedgwood design, of Galatea steering her shell over the waves, drawn by dolphins and attended by mermaids, tritons and cupids.

---

(1) L.P. I. ll.183-92.
(2) L.P. I. ll.85-92.
(3) L.P. I. ll.407-8.

Again, Tremella, a fungus which, Darwin had noticed, becomes a transparent jelly on frosty autumnal mornings, is described at some length as a maiden turned to a statue of ice.[1]

All these examples are taken from the first canto of the poem. One or two more plants require special mention, since they are of more than purely botanical interest. The first of these is Gloriosa Superba, which possesses six stamens, of which three mature before the others. Then,

> " - When Time's rude hand a bark of wrinkles spread
> Round her weak limbs, and silver'd o'er her head,
> Three other youths her riper years engage,
> The flatter'd victims of her wily age."[2]

This is followed by a simile describing the relationship between Ninon de l'Enclos and her natural son by Lord Jersey. In the first edition of the poem Ninon was described thus:

> "So NINON pruned her wither'd charms, and won
> With harlot-smiles her gay unconscious son.-"[3]

In the second edition of the poem these lines were altered, apparently at Anna Seward's instigation, to

> "So, in her wane of beauty, NINON won
> With fatal smiles her gay unconscious son.-"[4]

On receiving a copy of the second edition in 1790 Miss Seward wrote to Darwin;

(1) L.P. I. ll.427-66.
(2) L.P. I. ll.121-24.
(3) L.P. 1789. I. ll.125-6.
(4) L.P. I. ll.125-6.

> "Above all, I rejoice that you have yielded to my persuasions, and rescued Ninon from the injustice you have done to her charms, by the epithet withered, and to her merits by that of harlot. Ninon had solid and generous virtues, to balance her amorous frailty, and, though not always constant, was at no time indiscriminately licentious."[1]

The Memoirs of Ninon de l'Enclos had been published in an English translation "By a Lady" in 1776. The Introduction to this work gives an extract from The World for Thursday, July 12th 1753, describing the love of the Chevalier de Villiers, Lord Jersey's son, for his mother, Ninon de l'Enclos. He arrived in Paris, knowing nothing of his parentage.

> "He saw his mother - He fell in love with her. The increase, the vehemence of his passion, give the greatest disquiet to the affectionate matron. At last, when nothing but a discovery of the secret could put a stop to the impetuosity of his attempts, she carried him into her bedchamber, and pointing to a clock, cried Rash youth, look there! at that hour, two and twenty years ago, I was delivered of you in this very bed! It is a certain fact, that the unfortunate, abashed young man, flew into the garden, and fell upon his sword."[2]

Darwin's version may have been based directly on this account.

> "Clasp'd in his arms she own'd a mother's name,-
> 'Desist, rash youth! restrain your impious flame,
> 'First on that bed your infant form was press'd,
> 'Born by my thoes, and nurtured at my breast.'-
> Back as from death he sprung, with wild amaze
> Fierce on the fair he fixed his ardent gaze;

---

(1) Letters of Anna Seward. 1811. Vol.II. p.368.
(2) The Memoirs of Ninon de l'Enclos. Translated... By a Lady. 1776. Introduction. p.IX. cf. The World. No.29. (Thursday, July 12, 1753). The British Essayists. ed. James Ferguson. 1823. Vol.XXIII. p.152.

Dropp'd on one knee, his frantic arms outspread,
And stole a guilty glance toward the bed;
Then breath'd from quivering lips a whisper'd vow,
And bent on heaven his pale repentant brow;
"Thus, thus!" he cried, and plung'd the furious dart,
And life and love gush'd mingled from his heart."[1]

It seems likely, at any rate, that the passage was not written specially for the sake of Gloriosa Superba. The comparison is far-fetched and founded on only the slightest of resemblances. But it may well be that the episode had fired Darwin's imagination, that the description was written for its own sake, and that a context was afterwards found into which it could be fitted.

The second plant of particular interest is Ilex, or holly:

"Four of the giant brood with ILEX stand,
Each grasps a thousand arrows in his hand;
A thousand steely points on every scale
Form the bright terrors of his bristly mail.-
So arm'd, immortal Moore uncharm'd the spell,
And slew the wily dragon of the well.-
Sudden with rage their injur'd bosoms burn,
Retort the insult, or the wound return;
Unwrong'd, as gentle as the breeze that sweeps
The unbending harvests or undimpled deeps,
They guard, the Kings of Needwood's wide domains,
Their sister wives and fair infantine trains;
Lead the lone pilgrim through the trackless glade,
Or guide in leafy wilds the wandering maid."[2]

To this is attached a long footnote on the protective devices of different types of plants.[3] Moore is not mentioned. The reference is to a ballad, entitled,

---

(1) L.P. I. ll.127-38. It may be noted that Darwin, like the translator of the Memoirs exclaims "Rash youth!" The World gives "Rash boy."
(2) L.P. I. ll.161-74.
(3) L.P. I. l.161,n.

An Excellent Ballad of a most dreadful Combat, fought between Moore of Moore-Hall, and the Dragon of Wantley. It can be found in A Collection of Old Ballads, published in 1723. The anonymous compiler of the collection explains the story, and remarks that although the ballad is generally regarded as a "Criticism or Ridicule" of ballads of chivalry, some people think it was intended as a satire:

> "And to prove this they tell you, that in Days of Old, a certain Gentleman, a Member of the Law, and here represented by the Dragon, being left Guardian to Three Orphans, and finding some little Flaw in their Titles, put in his Claim, depriv'd them of their Estate, took Possession of it himself, and turn'd them over to the Parish. Upon which, another (here called Moore of Moore Hall) took up their Cause, sued the unjust Guardian, cast him, and recover'd the Estate for the Children."[1]

The ballad tells of the contest between the Dragon of Wantley "With seven heads and fourteen eyes", and "a furious knight" who ordered a new suit of armour for the occasion:

> "This being done he did engage
>   To hew this Dragon down;
> But first he went, new Armour to
>   Bespeak at Sheffield town;
> With Spikes all about, not within, but without,
>   Of Steel so sharp and strong;
> Both behind and before, Arms, Legs, and all o're
>   Some Five or Six inches long."[2]

These spikes are the "thousand steely points" of the "bristly mail" worn by Darwin's holly-tree. The footnote explains the special reference to the hollies of Needwood:

---

(1) A Collection of Old Ballads. 1723. p.37.
(2) Ibid., p.40.

"A curious circumstance attends the large hollies in Needwood-forest, they are armed with thorny leaves about eight feet high, and have smooth leaves above; as if they were conscious that horses and cattle could not reach their upper branches.... The numerous clumps of hollies in Needwood-forest serve as landmarks to direct the travellers across it in various directions; and as a shelter to the deer and cattle in winter; and in scarce seasons supply them with much food. For when the upper branches, which are without prickles, are cut down, the deer crop the leaves and peel off the bark."[1]

There is another reference to Needwood Forest in the fourth canto of the poem. Darwin describes Cereus, a tropical plant whose blossom opens only in the night. Then:

"Thus when old Needwood's hoary scenes the Night
Paints with blue shadow, and with milky light;
Where MUNDY pour'd, the listening nymphs among,
Loud to the echoing vales his parting song;
With measured step the Fairy Sovereign treads,
Shakes her high plume and glitters o'er the meads;
Round each green holly leads her sportive train,
And little footsteps mark the circled plain;
Each haunted rill with silver voices rings,
And Night's sweet bird in livelier accents sings."[2]

A footnote explains;

"Alluding to an unpublished poem by F.N.C.Mundy,Esq. on his leaving Needwood-Forest. See the passage in the notes at the end of this volume."[3]

The second part of this note, and the passage to which it refers, were added to the third edition of the poem. They are not in the first or second. The extract is entitled <u>Fairy-scene from Mr.Mundy's Needwood Forest.</u>[4]

---

(1) L.P. I. 1.161, n.
(2) L.P. IV. 11.33-42.
(3) L.P. IV. 1.35, n.
(4) L.P. p.189.

Francis Noel Clarke Mundy, member of an old Derbyshire family, who became Sheriff of the County in 1772, had made Darwin's acquaintance in the early 1770's. He was a man of literary tastes, devoted to country life and retirement. The Rev. Stebbing Shaw, in his History of Staffordshire, published in 1798, says that Mr. Francis Mundy rented Ealand Lodge, on the confines of Needwood Forest, as a hunting lodge. Here "he not only pursued the diversions of the chace with all the enthusiasm and ardour of the keenest sportsman, but at intervals (inspired with the thousand natural charms around him) penned that beautiful poem of 'Needwood Forest'."[1] Shaw says that it was privately printed, but that the bookseller Jackson of Lichfield brought out another, and unauthorised, edition, which Mundy bought up and suppressed. Miss Seward describes the work as "one of the most beautiful local poems that has been written."[2] It was occasioned, as Mundy explains, by an order from the Duchy Court of Lancaster, to which the forest belonged, for the felling of the timber. Mundy thus had to leave Ealand Lodge. His poem was printed in 1776. Miss Seward, writing about 1802, refers to Needwood as "the late pride and glory of Staffordshire, now sacrificing, with all its prostrate honors, to a popular scheme of apprehended utility."[3]

---

(1) Stebbing Shaw. The History and Antiquities of Staffordshire. 1798. Vol.I. p.68.
(2) Anna Seward. Memoirs of the Life of Dr.Darwin. 1804. p.59.
(3) Ibid., p.291.

The order for the felling of the trees aroused much indignation at the time. Mundy makes the Swilcar Oak, one of the most famous trees of the Forest, speak against the avarice and lust of gold of the times. Appended to the work are four short complimentary poems signed, in order, B.B., E.D.Jun., E.D., and A.S., B.B. is Sir Brooke Boothby. Of the others Miss Seward has something to say. In a letter written in 1792 she explains;

> "When Mr.Mundy had finished his enchanting local poem, the Needwood Forest, Dr.Darwin wrote three little poetic compliments on the work. To the best he put his son's initials; to the second best his own; and to the worst mine. Not a syllable of any of the three did I see, or hear of, till I saw them in print at the conclusion of Mr.Mundy's poems. I did not like this manoeuvre, and reproached him with it. He laught it off in a manner peculiar to himself, and with which he carries all his points of despotism."[1]

The poem signed E.D., entitled Address to the Swilcar Oak, is reproduced, with some emendation, in the Phytologia, published in 1800.[2] In 1808 Mundy published another poem, called The Fall of Needwood. In this he pays tribute to Darwin's medical skill and poetic ability, and alludes gratefully to the complimentary verses published with Needwood Forest.

The point that emerges is that Darwin's references to Needwood, and his quotation from Mundy's poem, arise out of

---

(1) Letters of Anna Seward. 1811. Vol.III. p.154.
(2) Phytologia. Sect. XVIII. 2. 16.

personal knowledge and interest. They are a compliment to a friend, intended for a small circle in the first place, but making known to a wider public, in the most tactful way possible, a work that was intended for private circulation only. The background of the lines is indeed extremely complex. Its complexity is further increased by the simile which follows the lines on Ilex. Darwin continues;

> "So WRIGHT'S bold pencil from Vesuvio's hight
> Hurls his red lavas to the troubled night;
> From Calpè starts the intolerable flash,
> Skies burst in flames, and blazing oceans dash;-
> Or bids in sweet repose his shades recede,
> Winds the still vale, and slopes the velvet mead;
> On the pale stream expiring Zephyrs sink,
> And Moonlight sleeps upon its hoary brink."[1]

A note explains that the allusion is

> "to the grand paintings of the eruptions of Vesuvius, and of the destruction of the Spanish vessels before Gibraltar; and to the beautiful landscapes and moon-light scenes, by Mr.Wright of Derby."[2]

As Anna Seward remarks, Wright's pictures bear no resemblance to holly; though she thought that "the poetic copy of these unallusive landscapes is transcendent."[3] The reference was, however, not really a simile, but a compliment. Joseph Wright of Derby was a well-known local artist. In 1770 both Darwin and his friend Thomas Day had stood to him for portraits. In 1784 he painted another picture of Darwin for

---

(1) L.P. I. ll.175-82. These lines were added in 1790.
(2) L.P. I. l.176, n.
(3) Anna Seward. Memoirs of the Life of Dr.Darwin. 1804. p.292.

Wedgwood, who gave him many commissions; and "A copy of Dr. Darwin" was executed for Sir Brooke Boothby. Darwin, on his part, attended Wright in his professional capacity. In 1784 Wright was commissioned by Wedgwood to paint The taking of Gibraltar. Darwin may also have been interested in Wright's paintings of scientific subjects, one of which was entitled Experiment with an Air-Pump, another, The Orrery.

Another plant in the first canto is interesting because it gives some indication of how the poem was put together. In the first edition Draba, belonging to the class Four Powers, was described thus:

> "Where rears huge Tenerif his azure crest,
> Aspiring DRABA builds her eagle nest;
> Pleased round the Fair four rival Lords ascend
> The shaggy steeps, two menial youths attend.
> High in the setting ray the beauty stands,
> And her tall shadow waves on distant lands."[1]

In the second edition the following was added after the second line:

> "Her pendant eyry icy caves surround,
> Where erst Volcanos min'd the rocky ground."[2]

The note attached to the plant was also enlarged:

> "There was formerly a Volcano on the Peake of Tenereif, which became extinct about the year 1684. Philos.Trans. In many excavations of the mountain, much below the summit, there is now found abundance of ice at all seasons. Tench's Expedition to Botany Bay, p.12. Are these congelations in consequence of the daily solution of the hoar-frost, which is produced on the summit during the night?"[3]

---

(1) L.P. 1789. I. 11.219-24.
(2) L.P. I. 11.253-4.
(3) L.P. I. 1.252, n.

A Narrative of the Expedition to Botany Bay, an account of the first deportation of convicts to Australia by Watkin Tench, Captain of Marines, was written in 1788 and published in 1789. The ship called at Tenerife, and the officers dined with the Governor of the island. Tench remarks;

> "At this entertainment the profusion of ices which appeared in the desert was surprising, considering that we were enjoying them under a sun nearly vertical. But it seems that the caverns of the Peake, very far below its summit, afford, at all seasons, ice in abundance."[1]

Darwin presumably read Tench's book after The Loves of the Plants had gone to press, noted a useful reference, and introduced it into the second edition of the poem. A recollection of a reference to the volcano in the Philosophical Transactions, noticed at some earlier date; a personal scientific conjecture; and the verse is thoroughly annotated. Since the note also contains observations on the stamens of the plant and comment on the effects of cultivation and cooking on the plants of this class, which in their raw state are acrid and antiscorbutic, not a little industry must have gone into its compilation.

The last plant in this canto which requires special notice is Rubia, or Madder, "cultivated in very large quantities for dying red."

---

(1) Watkin Tench. A Narrative of the Expedition to Botany Bay. 1789. (2nd ed. 1789. p.11.)

"With nice selection modest RUBIA blends
Her vermil dyes, and o'er the cauldron bends;
Warm 'mid the rising steam the Beauty glows,
As blushes in a mist the dewy rose.
With chemic art four favour'd youths aloof
Stain the white fleece, or stretch the tinted woof;
O'er Age's cheek the warmth of youth diffuse,
Or deck the pale-eyed nymph in roseate hues."[1]

This is followed by a description of Medea, restoring Aeson to youth in the waters of her cauldron. A note adds that

> "The story of AEson becoming young, from the medicated bath of Medea, seems to have been intended to teach the efficacy of warm bathing in retarding the progress of old age."[2]

Darwin thus reads a historical meaning into this legend or myth. This was not unprecedented. The Abbé Banier had said that some thought that the story signified "the Mystery of the Transfusion of Blood." His own opinion was that Medea's treatment was a drink made from herbs.[3] Darwin, however, had a firm belief in the value of warm baths. He expounds his theory at length elsewhere.[4] So that his interpretation was a natural one, in the light of his own medical opinions. It is perhaps worth noting, too, that Sir John Floyer, physician in Lichfield during the seventeenth

---

(1) L.P. I. ll.375-82.
(2) L.P. I. l.387, n.
(3) Ovid's Metamorphoses, in Latin and English, Translated by the Most Eminent Hands. With Historical Explications of the Fables, Written in French by the Abbot Banier.... Translated into English. Amsterdam. 1732. Vol.I. p.223.
(4) See The Temple of Nature. 1803. Add. Note VII.

century, had had an equally strong faith in cold bathing; and had erected a cold bath on the very ground which later became Darwin's botanic garden.[1]

In the second canto of the poem the botanic theme recedes into the background. The Linnaean system becomes a mere framework to support a body of topical reference, personal compliment, and meditation upon the progress of civilisation. Thus the first plant, Carlina, or the common thistle, whose winged seeds are dispersed by wind, is described in a curiously hybrid metaphor:

> " - Plume over plume in long divergent lines
> On whale-bone ribs the fair Mechanic joins;
> Inlays with eider down the silken strings,
> And weaves in wide expanse Daedalian wings;
> Round her bold sons the waving pennons binds,
> And walks with angel-step upon the winds."[2]

A note[3] informs the reader that the plant belongs to the class Confederate Males, and provides information on various methods of seed-dispersal; but there is no reference in the verse to Carlina's place in the Linnaean scheme. There follows, however, an account of the hot-air balloon invented by the brothers Montgolfier in 1782. The first balloon to carry a human passenger had been sent up on November 21, 1783; the first voyagers were the Marquis d'Arlandes, and Pilâtre

---

(1) Sir John Floyer wrote An Enquiry into the Right Use of Baths, 1697, and Medicina Geronocomica: or, the Galenic Art of Preserving Old Men's Healths. 1724. 25.
(2) L.P. II. 19-24.
(3) L.P. II. 1.7, n.

de Rozier, who in 1785 met his death in one of the early hydrogen balloons, and who was lamented in The Economy of Vegetation.[1] In the earlier poem, tribute is paid to the inventors. Darwin cries;

"Rise, great MONTGOLFIER! urge thy venturous flight
High o'er the Moon's pale ice-reflected light;"[2]

At this, James Keir was moved to faint protest. "Mrs. BLAIR", he remarks, "thinks you have sacrificed the philosopher to the poet when you speak of MONTGOLFIER, 'Urge thy venturous flight high o'er the moon', &c. Considering especially the poem as a philosophical one, fancy ought not to fly quite so high."[3]

The next three plants are among those which have been most useful to man: Lina, or flax, Gossypia, or the cotton plant; and Papyra.

"Inventress of the Woof, fair LINA flings
The flying shuttle through the dancing strings;
Inlays the broider'd weft with flowery dyes,
Quick beat the reeds, the pedals fall and rise;
Slow from the beam the lengths of warp unwind,
And dance and nod the massy weights behind.-
Taught by her labours, from the fertile soil
Immortal ISIS clothed the banks of Nile;
And fair ARACHNE with her rival loom
Found undeserved a melancholy doom-"[4]

We find here both Darwin's interest in machinery and industrial processes, and his belief in the significance of

---

(1) E.V. IV. ll.147-164. In the fourth edition of The Economy of Vegetation lines lamenting Miss Susan Dyer, who was engaged to marry M.Rozier and who died shortly after the disaster, are inserted in this passage. See. E.V. 1799.IV. ll.157-68.
(2) L.P. II. ll.47-48.
(3) Moilliet, op.cit., p.81.
(4) L.P. II. ll.67-76.

the ancient mythology as a record of the achievements of the human race. He explains in a note that flax was first found on the banks of the Nile, and that Isis was said to be the inventress of spinning and weaving. And he adds;

> "The fable of Arachne was to compliment this new art of spinning and weaving, supposed to surpass in fineness the web of the spider."[1]

For this type of interpretation there was good precedent in the work of many earlier writers on mythology. Thus the Abbé Banier explains that Arachne "was the ablest Artist of her Time at working in Silk and Wool."[2]

The cotton-plant serves to introduce a description in verse, amplified by a note, of the spinning machinery erected by Sir Richard Arkwright on the banks of the Derwent, near Matlock. The invention represents a step forward in human progress:

> "... since Sir Richard Arkwright's ingenious machine has not only greatly abbreviated and simplified the labour and art of carding and spinning the Cotton-wool, but performs both these circumstances better than can be done by hand, it is probable, that the clothing of this small seed will become the principal clothing of mankind;....."[3]

The verse description of the machinery[4] is not quite as successful as that of the loom, introduced in connection with Lina, or as that of Boulton's coining apparatus in The Economy of Vegetation,[5] since it is necessarily more complex and

---

(1) L.P. II. 1.67, n.
(2) Banier. op.cit., Vol.I. p.181.
(3) L.P. II. 1.87, n.
(4) L.P. II. 11.93-104.
(5) E.V. I. 11. 281-88.

technical. Darwin's own knowledge of Arkwright's machine was probably first-hand, for Arkwright was for many years a partner of William Strutt of Derby, who was himself a manufacturer, a prominent member of the ~~Literary and~~ Philosophical Society founded by Darwin, and a personal friend of the doctor. But though the verse is skilfully adapted to describe the different processes carried out by the machine, no clear picture emerges of its workings as a whole.

The Egyptian papyrus, vehicle of the written word, represents the opportunities for development and progress provided by the invention of a means of recording discoveries for the benefit of future generations. Thus;

> "Before the invention of letters mankind may be said to have been perpetually in their infancy, as the arts of one age or country generally died with their inventors."[1]

After explaining in verse the use of three kinds of written symbols, letters, numbers and musical notation, Darwin proceeds, by no very logical transition, to describe the art of Mrs.Delaney:

> "So now DELANEY forms her mimic bowers,
> Her paper foliage, and her silken flowers;
> Her virgin train the tender scissars ply,
> Vein the green leaf, the purple petal dye:
> Round wiry stems the flaxen tendril bends,
> Moss creeps below, and waxen fruit impends."[2]

---

(1) L.P. II. 1.105, n.
(2) L.P. II. ll. 155-60.

The details are given in a footnote:

"Mrs. Delaney has finished nine hundred and seventy accurate and elegant representations of different vegetables with the parts of their flowers, fructification, &c.according with the classification of Linneus, in what she terms paper-mosaic. She began this work at the age of 74, when her sight would no longer serve her to paint, in which she much excelled: between her age of 74 and 82, at which time her eyes quite failed her, she executed the curious Hortus siccus above-mentioned, which I suppose contains a greater number of plants than we were ever before drawn from the life by any one person. Her method consisted in placing the leaves of each plant with the petals, and all other parts of the flowers on coloured paper, and cutting them with scissars accurately to the natural size and form, and then pasting them on a dark ground; the effect of which is wonderful, and their accuracy less liable to fallacy than drawings. She is at this time (1788) in her 89th year, with all the powers of a fine understanding still unimpaired."[1]

Anna Seward commented upon Darwin's account in a letter written to her friend Mr. Saville in 1792, after she had seen Mrs.Delaney's hortus siccus.

"Of this astonishing work," she says, "Dr.Darwin has given a most erroneous description in his splendid poem. He ought not to have taken such a liberty. It represents Mrs. Delaney as a mere artificial flower-maker, using wires and wax, and moss, &.c.; though writing-paper was her sole material - her scissars her only implement. The former, previously coloured by herself, in complete shades of every tint, was never retouched by the pencil after the flower was cut out; nor did she ever make a drawing; but, as her specimen lay before her, she cut from the eye."[2]

The strange fact is, however, that Darwin's description, as it stands in the note, agrees remarkably well with Miss Seward's own account, given in the letter quoted above. It

(1) L.P. II. 1.155, n.
(2) Letters of Anna Seward. 1811. Vol.III. p.196.

is only in the verse that the words "wiry", "moss", and "wax" occur; and in their context these appear to be a part, not of the account of the actual process of the art, but of a figurative description of the finished effect.

Nevertheless, Darwin frequently showed his preference for fiction to truth, for poetry to philosophy, as the next section of the poem well illustrates. This is concerned with a class of plants, represented by Lapsana, Nymphaea alba, and Calendula, which open and close their petals at certain times of the day, and so constitute the Horologe, or Watch of Flora. These, we are told,

> "Watch with nice eye the Earth's diurnal way,
> Marking her solar and sidereal day,
> Her slow nutation and her varying clime,
> And trace with mimic art the march of Time."[1]

When these lines were submitted to Keir in 1787, he raised an objection: of the phrase "Marking her solar and sidereal day", he says;

> "Is this idea philosophically accurate? Your note informs that the equinoctial flowers open and shut at determinate hours, which seems as if they regarded time and not the sun. Are these flowers capable of flowering at any but determinate seasons; and if they are, has their uniformity of expanding and closing at the same hour been well ascertained? For my part I cannot conceive any possible connection between plants and true time."[2]

---

(1) L.P. II. ll.167-70.
(2) Moilliet, op.cit., p.80.

The passage was retained in spite of this protest, probably for the sake of the elaborate description of the mechanism of a watch, which follows it.

Each of the next three plants serves to introduce a subject derived from literary sources. Helleboras, the Christmas rose, whose petals after impregnation gradually turn green, leads to an account of the transformation of Nebuchadnezzar as described in the book of Daniel. This is a truly Ovidian metamorphosis; though the resemblance between Nebuchadnezzar and the Christmas rose is indeed but slight. After this comes Menispermum or Indian Berry, which, Darwin remarks, intoxicates fish. This affords an opportunity for the insertion of a verse-account of St.Anthony preaching to the fish, based on a passage in Joseph Addison's <u>Travels in Italy</u>.[1] The connection lies in the similarity between the effect on the fish of eating the berries of the plant, and the effect of St.Anthony's preaching:

> "The listening shoals the quick contagion feel,
> Pant on the floods, inebriate with their zeal,
> Ope their wide jaws, and bow their slimy heads,
> And dash with frantic fins their foamy beds."[2]

The last of these three plants is the poppy:

---

(1) Joseph Addison. <u>Remarks on the Several Parts of Italy, &c, in the years 1701,1702,1703</u>. 1705. (See. J.H.Moore. <u>A New and Complete Collection of Voyages and Travels</u>. 1785? Vol.II. p.917).
(2) L.P. II. ll.263-66.

"Sopha'd on silk, amid her charm-built towers
Her meads of asphodel, and amaranth bowers,
Where Sleep and Silence guard the soft abodes,
In sullen apathy PAPAVER nods."[1]

A note explains the effects of opium, and refers the reader to the Memoirs of Baron de Tott, of which a translation from the French had been published in 1786, for an account of the opium-eaters of Constantinople.[2] In verse, the enchantments of Papaver, according to Anna Seward, "are poetically given from old Tales of the Genii".[3] These are followed, rather oddly, by the enchantments of Emma Crewe, who had designed the frontispiece for The Loves of the Plants:

"So with her waving pencil CREWE commands
The realms of Taste, and Fancy's fairy lands;
Calls up with magic voice the shapes, that sleep
In earth's dark bosom, or unfathom'd deep";[4]

This, as Miss Seward remarked, is a compliment "of very forced introduction".[5]

There follows an interlude of pure poetic ornament. Cista, a plant whose petals last but a few hours and fall off at noon, arises with the dawn, addresses four quatrains to May, leads her troops "O'er the green brinks of Severn's oozy bed", and dies. Darwin follows this up with a simile of contrast, a picture of a frost-bound landscape overtaken by the thaw.

---

(1) L.P. II. ll.267-70.
(2) Memoirs of Baron de Tott. Translated from the French, 1786. Vol.I. p.141 ff.
(3) Anna Seward. Memoirs of the Life of Dr.Darwin. 1804. p.322.
(4) L.P. II. ll.295-98.
(5) Seward, op.cit., p.322.

From this we are transported to South America, home of the Peruvian bark-tree, or Cinchona, which in Darwin's time was still regarded as a plant of almost miraculous properties. It had not then been induced to grow in other countries, and the value of the drug was therefore increased by the difficulty with which it was obtained. Darwin gives the legendary account of the discovery of the virtues of the tree:

> "Several of these trees were felled for other purposes into a lake, when an epidemic fever of a very mortal kind prevailed at Loxa in Peru, and the woodmen, accidentally drinking the water, were cured;"[1]

This is elaborated into a poetic episode. Cinchona, "Fairest of Peruvian maids", calls Hygeia to the aid of sickening Loxa. Hygeia descends, attended by Youth and Joy, blesses the maid, and grants the request. Thereupon,

> "Five youths athletic hasten to her aid,
> O'er the scar'd hills re-echoing strokes resound,
> And headlong forests thunder on the ground."[2]

The populace, drinking from the water and so restored to health, are then compared to the followers of Moses, drinking the water struck from the rock. It can be seen that the personification becomes a little mixed; but this hardly troubles the reader who is not hypercritical. The same kind of confusion appears in the next episode, which deals with Digitalis. Darwin first describes Dropsy:

---

(1) L.P. II. 1.349, n.
(2) L.P. II. 11.392-94.

"Bolster'd with down, amid a thousand wants,
Pale Dropsy rears his bloated form, and pants;
"Quench me, ye cool pellucid rills!" he cries,
Wets his parch'd tongue, and rolls his hollow eyes."[1]

Hygeia again hears the cry. Assuming the dress of Digitalis she descends, attended by "four youths", and "charms the shapeless monster into man." In the footnote Darwin explains that

> "The effect of this plant in that kind of Dropsy, which is termed Anasarca, where the legs and thighs are much swelled, attended with great difficulty of breathing, is truly astonishing."[2]

He had himself been one of the first physicians to make use of Digitalis, whose properties were becoming generally known about the time when The Loves of the Plants was published. In the same footnote he remarks;

> "A theory of the effects of this medicine, with many successful cases, may be seen in a pamphlet called 'Experiments on Mucilaginous and Purulent Matter', published by Dr.Darwin, in 1780."[3]

This pamphlet consisted of two dissertations written by his eldest son Charles, shortly before his death. The first, entitled Experiments establishing a Criterion between Mucaginous and Purulent Matter, gained the prize medal of the Aesculapion Society of Edinburgh in 1778. The second, An Account of the Retrograde Motions of the Absorbent Vessels of Animal Bodies in some Diseases, which was designed as

(1) L.P. II. 11.415-18.
(2) L.P. II. 1.425, n.
(3) Ibid.

Charles Darwin's inaugural thesis for his degree, was later in part reprinted, also in an English translation - for the original was written in classical Latin - in the Zoonomia.[1] The publication of 1780 also contains a Life of the Author, written by Erasmus Darwin; and the work is dedicated to Dr. Andrew Duncan of Edinburgh, in whose family vault Charles Darwin was buried. The reference in The Loves of the Plants is thus an essentially personal one, a tribute to the brilliant promise of a dead son. To the general reader, the poem was anonymous, so that the personal note cannot have been obtrusive.

Digitalis leads to two further tributes; to the work of the Bishop of Marseilles during the Plague of 1720 and 1722, and to the philanthropic activity of Sir John Lawrence, Lord Mayor of London, during the Great Plague of 1665.[2] Darwin's account of the latter, given in a footnote, is based on Defoe's Journal of the Plague Year. This introduces the final theme of the canto, the work of John Howard:

> "- And now, PHILANTHROPY! thy rays divine
> Dart round the globe from Zembla to the Line;
> O'er each dark prison plays the cheering light,
> Like northern lustres o'er the vault of night.-
> From realm to realm, with cross or crescent crown'd,
> Where'er Mankind and Misery are found,
> O'er burning sands, deep waves, or wilds of snow,
> Thy HOWARD journeying seeks the house of woe."[3]

---

(1) Zoonomia. Vol.I. 1794 (2nd ed. 1796. p.306.)
(2) Cf. below, p.261ff.
(3) L.P. II. 11.439-46.

Howard was a national hero at the time. William Hayley's Ode, published in 1780, had expressed popular feeling; and it was followed by many more works of approbation, of which Darwin's is one of the latest. In 1786, a suggestion put forward in the Gentleman's Magazine had resulted in the launching of a scheme to erect a monument to Howard. Subscriptions poured in; and among the subscribers occur the names of Darwin, Wedgwood, Anna Seward, and others of their circle. The hero, however, refused to allow the monument to be erected, and the money was put to other uses. In 1788 and 1789 Howard visited Lichfield several times, and on at least one occasion called on Miss Seward, who describes him as "the most distinguished excellence that ever walked the earth". These visits may have been the direct inspiration of Darwin's lines. It seems, however, that they never reached Howard himself. James Baldwin Brown, in his Memoirs of the Public and Private Life of John Howard, the Philanthropist, published in 1818, says that,

> "...after the lines of Dr.Darwin had been for some time before the public, he assured a friend, who asked whether he had seen them, that he never read anything written in his praise, adding, that no-one could disoblige him so much as by mentioning him in any publication whatever."[1]

The prevailing tone of the third canto is one of deep gloom; and here and there Darwin touches a note of

---

(1) James Baldwin Brown. Memoirs of the Public and Private Life of John Howard, the Philanthropist. 1818. p.573.

mysterious horror, that indicates that he is attuned to this new demand of the period. The first plant, Circaea, or Enchanter's Nightshade, "much celebrated in the mysteries of witchcraft, and for the purpose of raising the devil,"[1] appears as a Sorceress, attended by two imps. They make their way across a graveyard, enter the church, and then,

> "Their impious march to God's high altar bend,
> With feet impure the sacred steps ascend;
> With wine unbless'd the holy chalice stain,
> Assume the mitre, and the cope profane;
> To heaven their eyes in mock devotion throw,
> And to the cross with horrid mummery bow;
> Adjure by mimic rites the powers above,
> And plight alternate their Satanic love."[2]

Darwin, to whom all religious rites contained something of superstition, probably felt nothing unsuitable or incongruous in the use of profane rites to illustrate a botanical fact.

The next plant, the laurel, is described as a Pythian priestess, surrounded by twenty priests, delivering an oracle. A note explains that "The Pythian priestess is supposed to have been made drunk with infusion of laurel-leaves when she delivered her oracles."[3] Her state of intoxication is compared, in the verse, to the state of horror produced by a nightmare;

> "- Such as of late amid the murky sky
> Was mark'd by FUSELI'S poetic eye."[4]

---

(1) L.P. III. 1.7, n.
(2) L.P. III. 11.31-38.
(3) L.P. III. 1.40, n. Darwin's remarks on poisons here appear to be inspired by Richard Mead's Mechanical Account of Poisons. 1708. (See 3rd ed. 1745. p.268 ff.).
(4) L.P. III. 11.55-56.

Fuseli's popular picture, The Nightmare, had been painted in 1781, so that the reference was highly topical. It may also have been a personal compliment, since Fuseli provided the frontispiece for The Economy of Vegetation; though we cannot tell whether he had been entrusted with the commission before The Loves of the Plants was published.

The Sorceress and the Nightmare are followed by Druidical sacrifices, introduced by way of Fica, or Indian Fig. Fica allows some of its branches to take root in the ground, and then rise up to the light again. These Darwin compares to the Hamps and Manifold, rivers of Derbyshire which flow underground for some distance, and then re-emerge into the open. The comparison is forced, but it allows the introduction of an account of a cavern, known as Thor's House, near the place at which these rivers disappear into the ground. Darwin, remarking that "The Druids are said to have offered human sacrifices inclosed in wicker idols to Thor",[1] depicts the performance of such a sacrifice in Thor's House. The episode appears to be introduced purely for its literary effect; there is no speculation concerning the nature and origins of Druidical worship. Darwin nowhere enters upon this topic, so clear to many students of mythology during this period.

(1) L.P. III. 1.90, n.

He turns next to classical sources of the horrid. Impatiens, or Touch me not, which disperses its seeds by discharging them violently from the seed-vessel, is compared, at great length, to Medea hurling her murdered children from her. This time the comparison is not only forced; it also goes beyond the bounds of congruity. In this canto, however, Darwin is obviously more concerned with the separate literary episodes introduced in the wake of the plants, than he is with botanical instruction. The plants are merely pegs upon which to hang pictures in verse. The notes, nevertheless, remain scientific in tone, and the combined effect is strange. Thus, to Impatiens is attached a note describing a hygrometer constructed by Richard Lovell Edgeworth in the early days of his friendship with Darwin.[1] This was of scientific interest; and it was also a personal compliment, which was duly appreciated. "To have my name in a note in your work", wrote Edgeworth, on receiving a copy of the poem, "is, in my opinion, to have it immortal."[2]

There follows a group of poisonous plants. No details of their place in the Linnaean scheme are given, but to each is attached a note describing the toxic qualtities of the plant.

---

(1) L.P. III. l.131, n.
(2) Edgeworth, op.cit., p.324.

"If rests the traveller his weary head,
Grim MANCINELLA haunts the mossy bed,
Brews her black hebenon, and,stealing near,
Pours the curst venom in his tortured ear.-
Wide o'er the mad'ning throng URTICA flings
Her barbed shafts, and darts her poison'd stings.
And fell LOBELIA'S suffocating breath
Loads the dank pinion of the gale with death."[1]

The final couplet makes a formal link with the botanic theme:

"- With fear and hate they blast the affrighted groves,
Yet own with tender care their kindred Loves! -"[2]

These are preceded, however, by one plant, which, though not placed by Darwin in the category of poisonous plants, is nevertheless possessed of alarming properties. Dictamna, or Fraxinella, in dry weather emits in the evenings "an inflammable air or gas, and flashes on the approach of a candle."[3] The details in the notes appended to all four plants are derived from a variety of sources. But it seems possible that the passage was inspired in the first place by a reading of John Ingenhousz's Experiments upon Vegetables, published in 1779. This work is concerned with the evolution of different gases by plants, and in the course of it Ingenhousz mentions the exhalations produced by Mancinella, Lobelia, and Fraxinella.[4] The plants are grouped together; and Darwin may well have noted them as useful material, and added to them Urtica, or the nettle. These harmful plants

(1) L.P. III. ll.187-94.
(2) L.P. III. ll.195-96.
(3) L.P. III. l.184, n.
(4) John Ingenhousz. Experiments upon Vegetables. 1779. p.145.

are compared, in the verse, to beasts of prey roaming among the ruins of Palmyra. The source of the description of Palmyra is given in a note as Volney's Travels, of which an English version had been published two years before the appearance of The Loves of the Plants.[1]

Literature of travel also provides the next poetic episode of this canto. In the London Magazine for 1784 there had appeared an account, translated from the Dutch of N.P.Foersch, of the poison tree of Java.[2] Darwin had the English version reprinted in the Additional Notes to his poem, summarised it in a footnote, and gave a long verse description of it.[3] Anna Seward was pleased with the result. She said;

> "I never read anything more shudderingly interesting than the Poison Tree of Java."[4]

Mrs Schimmelpennincke was less impressed. In her Autobiography she wrote;

> ".... my dear mother said to him, 'I was much pleased, Doctor, with your magnificent description of the Upas; but I was also much surprised, and more especially at the notes containing an elaborate account of it, for I had always considered what we heard of the Upas as a myth.' The Doctor laughingly replied, 'And so do I, my dear Madam. There is not one word of truth in it; but so long as I can get the public to believe me, by dint not only of my own poetry, but also by the notes of my ingenious friend, and as every line puts ten shillings in my pocket, I shall go on ad infinitum, as haply the monks of old did with their equally true saintly legends.'"[5]

---

(1) Constantin François de Volney. Travels through Syria and Egypt in 1783, 1784 and 1785. Translated 1787. Vol.II.p.277.
(2) London Magazine. October, 1784. p.511.
(3) L.P. Add. Notes. p.183; III. ll.219-258.
(4) Letters of Anna Seward. 1811. Vol.II. p.265.
(5) Life of Mary Anne Schimmelpenninck. ed. Christiana Hankin. 1858. Vol.I. p.247.

Mrs. Schimmelpennincke was no friend of Darwin. But it is remarkable how often his contemporaries remark upon his lack of regard for scientific accuracy, when attractive material for poetic treatment offers itself.

The following plant, Orchis, did not appear in the first edition of the poem. It was added in 1790, together with the elaborate and pathetic episode which is attached to it. In a note Darwin explains that

> "The Orchis morio in the circumstance of the parent-root shrivelling up and dying, as the young one increases, is not only analogous to other tuberous or knobby roots, but also to some bulbous roots, as the tulip."[1]

In verse this phenomenon reads;

> "With blushes bright as morn fair ORCHIS charms,
> And lulls her infant in her fondling arms;
> Soft plays Affection round her bosom's throne,
> And guards his life, forgetful of her own."[2]

To Orchis is compared, first, a wounded deer fleeing with her fawn, and then Eliza, accompanied by her two children, seeking her husband on the battle-field of Minden. As she catches sight of her husband's crest through the smoke, a stray bullet strikes her down; and the soldier returning safe from the fight, comes upon his dead wife, clasping the children to her breast. At first he is distraught with grief. Then;

---

(1) L.P. III. 1.259, n.
(2) L.P. III. 11.259-62.

'Oh, Heavens!' he cried, 'my first rash vow forgive;
These bind to earth, for these I pray to live!'-
Round his chill babes he wrapp'd his crimson vest,
And clasp'd them sobbing to his aching breast.[1]

Darwin gives no indication of the source of this story. It may have been his own invention. One wonders, however, what focussed his attention upon the battle of Minden, fought in 1759; and why the episode was introduced only in the second edition of the poem. Was it added, too, for the sake of the long footnote on the structure of the bulbs, attached to Orchis? Or was Orchis the excuse for Eliza? We cannot tell.

After this excursion into recent history, Darwin turns again to the classics. Cuscuta, or Dodder, a parasite plant which climbs upon its victims and sucks its nourishment from them, is compared to the serpents encircling Laocoon and his sons. Then comes Vitis, the vine, also, it may be noticed in passing, a climbing plant. The point here, however, is the harmful effect on the human body of spirituous liquors:

""Drink deep, sweet youths", seductive VITIS cries,
The maudlin tear-drop glittering in her eyes;
Green leaves and purple clusters crown her head,
And the tall Thyrsus stays her tottering tread.
-Five haples swains with soft assuasive smiles
The harlot meshes in her deathful toils;
"Drink deep", she carols, as she waves in air
The mantling goblet, "and forget your care".-

---

(1) L.P. III. 11.325-28.

O'er the dread feast malignant Chemia scowls,
And mingles poison in the nectar'd bowls;
Fell Gout peeps grinning through the flimsy scene,
And bloated Dropsy pants behind unseen;
Wrapp'd in his robe white Lepra hides his stains,
And silent Frenzy writhing bites his chains."[1]

The moral is reinforced by a note, in which Darwin's opinion is expressed in strong terms:

> "The juice of the ripe grape is a nutritious and agreeable food, consisting chiefly of sugar and mucilage. The chemical process of fermentation converts this sugar into spirit, converts food into poison! And it has thus become the curse of the Christian world, producing more than half our chronical diseases; which Mahomet observed, and forbade the use of it to his disciples. The Arabians invented distillation; and thus, by obtaining the spirit of fermented liquors in a less diluted state, added to its destructive quality. A Theory of the Diabaetes and Dropsy, produced by drinking fermented or spirituous liquors, is explained in a Treatise on the inverted motions of the lymphatic system, published by Dr.Darwin, Cadell."[2]

This is one of the few subjects on which Darwin expresses himself with a passionate conviction. His objection to the drinking of fermented liquor was no doubt based on the results he had observed in the course of his medical practice; and he certainly used his personal influence to war against intemperance among his acquaintances. Anna Seward says of him;

---

(1) L.P. III. 11.357-70.
(2) L.P. III. 1.357, n.

"It is well known, that Dr.Darwin's influence and example have sobered the county of Derby; that intemperance in fermented fluid of every species is almost unknown among it's gentlemen."[1]

This, in the eighteenth century, was a remarkable achievement. In the poem Darwin stresses his warning with an account of the sufferings of Prometheus:

"The antient story of Prometheus, who concealed in his bosom the fire he had stolen, and afterwards had a vulture perpetually gnawing his liver, affords so apt an allegory for the effects of drinking spirituous liquors, that one should be induced to think the art of distillation, as well as some other chemical processes (such as calcining gold), had been known in times of great antiquity, and lost again. The swallowing drams cannot be better represented in hieroglyphic language than by taking fire into one's bosom; and certain it is, that the general effect of drinking fermented or spirituous liquors is an inflamed, schirrous, or paralytic liver, with its various critical or consequential diseases, as leprous eruptions on the face, gout, dropsy, epilepsy, insanity."[2]

Here, again, is evidence of Darwin's interest in mythology and hieroglyphics; although the particular interpretation of the Prometheus story is probably entirely his own, and more than half humorous in intention. The fable had, however, been explained by other writers. The Abbé Banier had noted that it had been interpreted as an allegory of an exiled prince, who contemplated the stars from Mount Caucasus, and was consumed by his own meditations.[3]

(1) Anna Seward. Memoirs of the Life of Dr.Darwin, 1804.p.5.
(2) L.P. II. 1.371, n.
(3) Banier, op.cit., Vol.I. p.5.

The next plant, Cyclamen, which pushes its own seeds into the earth, serves to introduce another "historical" episode. Cleone, whose husband and six daughters had perished in the Plague of 1665, finally held her last child, her only son, dead in her arms. She made her way to the Charterhouse, dropped the child into the grave,

"And living plunged amid the festering dead". [1]

Darwin quotes Defoe's Journal of the Plague Year as his authority for the description of the Charterhouse grave. [2] He was evidently interested in Defoe; for in a letter written to Wedgwood in 1789 he recommends the History of Colonel Jacque to his friend's attention. [3] His preoccupation with the Plague may perhaps be explained by the fact that Eyam, the Derbyshire village which was Anna Seward's birthplace, was one of the last places in England to be visited by the Great Plague of 1665. There was a strong local tradition attached to the name of William Mompesson, rector of Eyam, who had refused to desert his parishioners, had tended the sick, had preached out of doors to avoid spreading infection, and had lost his wife before the plague abated. Thomas

---

(1) L.P. III. l.412.
(2) cf. L.P. II. l.435, n.
(3) The letter is preserved at Down House. Darwin explains that the work contains a story "of the generous spirit of black slaves, when kindly used", which might be useful as propaganda for the Abolitionist cause.

Seward, Anna's father, possessed copies of three letters written by Mompesson; so that Darwin may have had some personal interest in the circumstances of his life. There is a letter written by Anna Seward in 1765, preserved in Sir Walter Scott's edition of her Poetical Works, in which an account is given of the heroism of Mompesson, who

> "Drew, like Marseilles' good bishop, purer breath
> When nature sickened, and each gale was death."[1]

These lines, quoted from Pope's Essay on Man, should be compared with Darwin's reference to

> "Marseilles' good Bishop, London's generous Mayor,"[2]

in the second canto of The Loves of the Plants.

Darwin, as a physician, must have been familiar with the pamphlets occasioned by the outbreak of the plague in Marseilles in 1720. Richard Mead's Discourse on the Plague, first published in 1720, reached the ninth edition in 1744; and Richard Bradley's The Plague at Marseilles Consider'd went through four editions in 1721.[3] Even in 1790, the plague must still have been of living interest; and stories such as that related by Darwin must have been still current.

Cyclamen is followed by Cassia, an American plant, of which the seeds are carried by the sea to the coast of

---

(1) The Poetical Works of Anna Seward. ed. Walter Scott, 1810. p. clx. Scott notes that John Howard visited Eyam, the year before he last left England, to examine the vestiges of the calamity. p.clix.
(2) L.P. II. 1.435.
(3) Bradley remarks upon the "undaunted Courage" of the Bishop of Marseilles. See The Plague at Marseilles Consider'd. 1721. (4th ed. 1721. Preface. p.x.)

Norway. Cassia, entrusting her children to the flood, is compared to the mother of Moses, lodging the infant in the bulrushes. Then;

"-Erewhile majestic from his lone abode,
Embassador of Heaven, the Prophet trod;
Wrench'd the red Scourge from proud Oppression's hands,
And broke, curst Slavery! thy iron bands."1

This denunciation of slavery leads to the climax and final section of the canto, an appeal to the rulers of Britain to end the Slave Trade:

"E'en now, e'en now, on yonder Western shores
Weeps pale Despair, and writhing Anguish roars:
E'en now in Afric's groves with hideous yell
Fierce SLAVERY stalks, and slips the dogs of hell;
From vale to vale the gathering cries rebound,
And sable nations tremble at the sound! -
- YE BANDS OF SENATORS! whose suffrage sways
Britannia's realms, whom either Ind obeys;
Who right the injured,and reward the brave,
Stretch your strong arm, for ye have power to save!
Throned in the vaulted heart, his dread resort,
Inexorable CONSCIENCE holds his court;
- -
Hear him, ye Senates! hear this truth sublime,
"HE, WHO ALLOWS OPPRESSION, SHARES THE CRIME."2

When Darwin sent Wedgwood a copy of the first edition of the poem, he accompanied the volume with a letter. This began;

"Herewith you will receive the Botanic Garden, of which I am the supposed, not the avow'd author. After you have read the page on the Slave-trade 117, & the eulogy on Mr Howard's Humanity in visiting prisons p.80 - I do not insist on your reading any more."3

(1) L.P. III. 435-38.
(2) L.P. III. 11.441-56.
(3) Preserved at Down House. This is the letter mentioned above, note 3 p.261

In contrast with the dark tones of this canto, the fourth and last stands out in light relief. Darwin gives full rein to his gift of humorous fancy. The numerous plants are not connected by any special qualities or associations, but there is a superficial unity of mood and style and a profusion of decoration in Darwin's characteristic manner. The total effect would perhaps have been more pleasing if fewer plants had been treated at greater length. As it is, the lack of contrast within the canto, the rapid transition from scene to scene, episode to episode, and the inevitable similarity to the first canto, tend to make the reader feel that this has gone on just a little too long. The botanic scheme has lost its novelty, and the material is not quite sufficient to maintain interest at full pitch. Nevertheless, there are many delightful pictures, drawn from a variety of sources; and the notes contain much that is of interest concerning Darwin's theories of plant life.

Some of the ornamental passages are aptly drawn from classical sources. Thus the Conserva aegragrophila, a water plant, which "is found loose in many lakes in a globular form" and "rolls from one part of the lake to another", is compared to Leander swimming the Hellespont.[1] Arum, or

---

(1) L.P. IV. ll.367-94.

Cuckow-pint, of the class Feminine Males, introduces a description of Deianira, dressed in Hercules' lion-skin and carrying his club.[1] Trapa, a plant with both aerial and aquatic leaves, belonging to the class Tetrandria, appears as a Nymph, pursued by four Nereids.[2] Bellis Prolifera, the Hen and Chicken Daisy, is a vegetable monster in which

> ".... not only the impletion or doubling of the petals takes place.... but a numerous circlet of less flowers on peduncles, or footstalks, rise from the sides of the calyx, and surround the proliferous parent."[3]

In verse this becomes

> "Spring! with thy own sweet smile, and tuneful tongue,
> Delighted BELLIS calls her infant throng.
> Each on his reed astride, the Cherub-train
> Watch her kind looks, and circle o'er the plain;
> Now with young wonder touch the sliding snail,
> Admire his eye-tipp'd horns, and painted mail;
> Chase with quick step, and eager arms outspread,
> The pausing butterfly from mead to mead;"[4]

Bellis and her cherub-train are then compared to Venus and "her gold-hair'd family of Loves". The Cupids, drawn, perhaps, from Wedgwood designs, are engaged in forging arrows in Vulcan's furnace, scaring beetles, and pursuing "the gilded fly".

The fashion for the Chinese is not neglected. To the second edition of the poem Darwin added Cannabis, a new species of hemp recently introduced from China, which had

---

(1) L.P. IV. ll.283-302.
(2) L.P. IV. ll.205-20.
(3) L.P. IV. l.148, n.
(4) L.P. IV. ll. 147-54.

been described in the Philosophical Transactions for 1782.[1]

Cannabis affords a landscape:

"From Time's remotest dawn where China brings
In proud succession all her Patriot-Kings;
O'er desert-sands, deep gulphs, and hills sublime,
Extends her massy wall from clime to clime;
With bells and dragons crests her Pagod-bowers,
Her silken palaces, and porcelain towers;
With long canals a thousand nations laves;
Plants all her wilds, and peoples all her waves;
Slow treads fair CANNABIS the breezy strand,
The distaff streams dishevelled in her hand;"[2]

Another exotic picture springs from a plant known as Fairchild's mule, a hybrid produced by Dianthus superbus, or Proud Pink, and Caryophyllus, or Clove. A lengthy note[3] acquaints the reader with a variety of facts concerning animal and vegetable mules. In the verse, the hybrid serves to introduce a description of the love between the Nightingale and the Rose:

"So, when the Nightingale in eastern bowers
On quivering pinion woos the Queen of flowers;
Inhales her fragrance, as he hangs in air,
And melts with melody the blushing fair;
Half-rose, half-bird, a beauteous Monster springs,
Waves his thin leaves, and claps his glossy wings;
Long horrent thorns his mossy legs surround,
And tendril-talons root him to the ground;
Green films of rind his wrinkled neck o'erspread,
And crimson petals crest his curled head;
Soft-warbling beaks in each bright blossom move,
And vocal Rosebuds thrill the enchanted grove!"-[4]

---

(1) Experiments with Chinese Hemp Seed, a letter from Keane Fitzgerald to Sir Joseph Banks. Philosophical Transactions LXXII. (1782). p.46.
(2) L.P. IV. ll.107-16.
(3) L.P. IV. l.303, n.
(4) L.P. IV. ll.309-20.

This episode may have been inspired by one of the letters of Lady Mary Wortley Montague, which had been published in an unauthorised edition in 1763. One of the letters includes a translation of a Turkish love-poem, which contains a reference to the nightingale's passion for the rose, and Lady Mary explains;

> "The first verse is a description of the season of the year; all the country being now full of nightingales, whose amours with roses is an Arabian fable, as well known here as any part of Ovid amongst us."[1]

English folk-lore, too, contributes its quota to the poem. The fairy scene in Mundy's Needwood Forest has already been mentioned. In addition to this, we have Caprifica, or the wild fig, which Darwin explains thus:

> "The fruit of the fig is not a seed-vessel, but a receptacle inclosing the flower within it. As these trees bear some male and some female flowers, immured on all sides by the fruit, the manner of their fecundation was very unintelligible, till Tournefort and Pontedera discovered, that a kind of gnat produced in the male figs carried the fecundating dust on its wings.... and penetrating the female fig, thus impregnated the flowers; for the existence of this wonderful fact, see the word Caprification, in Milne's Botanical Dictionary."[2]

In the verse, the idea is elaborated:

> "Closed in an azure fig by fairy spells,
> Bosom'd in down, fair CAPRI-FICA dwells; -
> -

---

(1) The Letters and Works of Lady Mary Wortley Montagu. Ed. Wharncliffe. 1898. Vol.I. p.182.
(2) E.V. IV. l. 412, n. See Colin Milne. A Botanical Dictionary. 1770. art. Caprification.

-And now the talisman she strikes, that charms
Her husband - Sylph, - and calls him to her arms.-
Quick, the light Gnat her airy Lord bestrides,
With cobweb reins the flying courser guides,
From crystal steeps of viewless ether springs,
Cleaves the soft air on still expanded wings;
Darts like a sunbeam o'er the boundless wave,
And seeks the beauty in her secret cave."[1]

A plant added to the second edition of the poem was Ocyma, a botanical curiosity. Darwin informs us that,

> "The Abbe Molina, in his History of Chili, translated from the Italian by the Abbe Grewvel, mentions a species of Basil, which he calls Ocymum salinum; he says it resembles the common basil, except that the stalk is round and jointed; and that though it grows sixty miles from the sea, yet every morning it is covered with saline globules, which are hard and splendid, appearing at a distance like dew; and that each plant furnishes about half an ounce of fine salt every day, which the peasants collect, and use as common salt, but esteem it superior in flavour."[2]

Molina's Essai sur l'Histoire Naturelle du Chili was published in the French version by Gruvel in 1789, the year in which the first edition of The Loves of the Plants appeared. Darwin's note is practically a literal translation of Gruvel's account of the plant. His verse description is followed by a simile depicting Lot's wife turned to a pillar of salt as she looks back upon Gomorrah. The addition of this episode necessitated a removal of the description of the Polish salt-mines, which in the first edition of the poem followed Truffelia, a fungus which grows beneath the surface of the ground. The salt-mines were

---

(1) L.P. IV. ll.411-28.
(2) L.P. IV. l.225, n. See G.I. Molina. Essai sur l'Histoire Naturelle de Chili, 1789. p.109.

accordingly transferred to The Economy of Vegetation, and a few lines were added to Truffelia, to complete the picture of her subterranean dwelling.[1]

This selection gives some idea of the range of delicate fancy and whimsical humour which Darwin displays in this canto of the poem. It represents him in his lightest vein, and if we consider the verse alone, it is difficult to remember that the author of this sportive verse is also a man of robust intellect and vigorous conviction. The range of inquiry and speculation which appears in the notes, however, gives ballast to the playful and decorative verse.

One of the most important of these notes is that on Chunda, or Hedysarum Gyrans, an African plant. Darwin explains that,

> "Chundali Borrum is the name which the natives give to this plant; it is the Hedysarum gyrans, or moving plant; its class is two brotherhoods, ten males. Its leaves are continually in spontaneous motion; some rising and others falling; and others whirling circularly by twisting their stems; this spontaneous movement of the leaves, when the air is quite still and very warm, seems to be necessary to the plant, as perpetual respiration is to animal life. A more particular account with a good print of the Hedysarum gyrans is given by M.Broussonet in a paper on vegetable motions in the Histoire de l'Académie des Sciences. Ann. 1784. p.609."[2]

The reference to Broussonet, together with the annexed print, which is a reproduction, with slight modification,

---

(1) See The Ratiocination of Philosophy, p.97
(2) L.P. IV. 1.335, n.

of that attached to Broussonet's paper, was added to the second edition of the poem. The paper is called Essai de Comparaison entre les Mouvements des Animaux et ceux des Plantes. The author points out that although plants respond mechanically to certain stimuli, the movements so produced are not spontaneous. He nevertheless suggests that,

> "L'Influence des causes externes modifie quelquefois les mouvements vitaux dans les plantes, de manière qu'on seroit tenté de les attribuer à la volonté, comme ceux qui dépendent entièrement de cette faculté dans les animaux."[1]

He does not pursue this line of thought, but explains that the reproductive organs of plants are the only parts endowed with irritability, and that numerous examples could be cited of the movements of stamens and pistils. He describes the Chundali Burum, classified by Linnaeus as Hedysarum gyrans, and says that although it appears to enjoy spontaneous movement, it shows no sign of irritability when touched.

Darwin assumes that the movement of the plant is in fact spontaneous. He gives other instances of spontaneous vegetable movement, and adds

> "......that as the sleep of animals consist in suspension of voluntary motion, and as vegetables are likewise subject to sleep, there is reason to conclude, that the various actions of opening and closing their petals and foliage may be justly ascribed to a voluntary power: for without the faculty of volition, sleep would not have been necessary to them."[2]

---

(1) Broussonet. Essai de Comparaison entre les Mouvements des Animaux et ceux des Plantes. Histoire de l'Académie des Sciences. 1784. p.615.
(2) L.P. IV. 335, n.

This statement sums up many observations scattered through the notes of the poem. Darwin takes plant sleep as a fact, although there was no decisive evidence for it, and assumes from this their voluntarity, since sleep, according to his own definition, "consists in the abolition of all voluntary power, both over our muscular motions and our ideas."[1] The argument goes round in a circle. It reveals Darwin at work, however, on the building up of the analogy between animals and plants which reaches its final form in the Phytologia. Furthermore, his assumptions of plant sensitivity and voluntarity were by no means without precedent. The whole subject had been a controversial one for some years. Darwin's immediate predecessor, and perhaps his inspiration, was Thomas Percival, President of the Literary and Philosophical Society of Manchester. In 1784, the year in which Darwin became a member of this society, Percival published a paper entitled Speculations on the Perceptive Powers of Vegetables, in which he sought to demonstrate that plants are possessed of a certain degree of perceptivity and sensitivity; and his demonstration involves the drawing of an analogy between animal life and plant life. Like Darwin's, Percival's argument is based, not on observation and experiment, but on analogy and hypothesis. Another upholder of the doctrine was James

---

(1) L.P. III, 1.74, n.

Edward Smith, who in a paper read before the Royal Society in 1788,[1] sought to shew, not only that plants are possessed of an irritability which is not to be confused with a mechanical reaction, but also that certain plants seem to be endowed with a kind of spontaneous motion. No one, however, seems to have taken the idea as far as Darwin.

Since plants are thus perceptive, sensitive, and to a certain degree possessed of voluntary power, he regards evident adaptation to environment as in part the result of conscious effort. Thus the hollies in Needwood Forest arm their lower leaves with protective spikes, while the upper leaves, which are beyond the reach of animals, are smooth.[2] In the note on Curcuma, which has four filaments without anthers, Darwin makes a definite suggestion that some evolutionary process is taking place in the organic world.[3] This foreshadows his complete theory, as it was later set out in the Zoonomia and The Temple of Nature. And it is perhaps remarkable that none of his friends in their letters of praise and criticism of The Loves of the Plants, seem to have commented on this passage. The idea of evolution was not new or original, but it was still sufficiently unorthodox and undeveloped, at least in England, to excite comment.

---

(1) James Edward Smith. Some Observations on the Irritability of Vegetables. Philosophical Transactions. LXXVIII.(1788). p.158.
(2) L.P. I. 1.161, n.
(3) L.P. I. 1.65, n.

Another scientific theory expressed in notes attached to various plants in the poem is concerned with the relation between plants and insects. Darwin is convinced that the depredations of insects upon the plant nectar is harmful to the flower, and cites many instances of protective devices which he supposes to have been evolved in self-defence. Among these he notes an example of "imitation", and puts upon it the interpretation which fits his theory:

> ".... there is a curious contrivance attending the Ophrys, commonly called the Bee-orchis, and the Fly-orchis, with some kinds of Delphinium, called the Bee-larkspurs, to preserve their honey; in these the nectary and petals resemble in form and colour the insects, which plunder them: and thus it may be supposed, they often escape these hourly robbers, by having the appearance of being pre-occupied."[1]

Another small group of notes indicates his view of the fundamental importance of the study of botany to mankind. Avena, or Oat, excites the comment that

> "It seems to have required more ingenuity to think of feeding nations of mankind with so small a seed, than with the potatoe of Mexico, or the bread-fruit of the Southern islands; hence Ceres in Egypt, which was the birthplace of our European arts, was deservedly celebrated amongst their divinities, as well as Osyris, who invented the Plough."[2]

In a note on Muschus, or coral-moss, he reflects that since this plant is for many months of the year the sole food of the reindeer of the northern countries, and since the reindeer is the only sustenance of the human race during the same period, it is the support of some millions of mankind.[3]

---

(1) L.P. I. 1.243, n.
(2) L.P. IV. 1.73, n.
(3) L.P. IV. 1.357.

Again, he suggests that the roots of certain plants not now used for food might be made suitable for human consumption by cultivation and cooking.[1]

The notes are, in fact, an almost inexhaustible source of curious and useful information, ingenious theory and bold conjecture, as well as of botanical information. Few poems, except The Economy of Vegetation and The Temple of Nature can have been made to bear such a weight of instruction. In the first of the three poems to be published, however, the notes are comparatively limited in scope and volume. There is, in general, one to each plant. This contains the necessary botanical facts, together with any other material of particular relevance or interest. The Additional Notes, too, contain added detail and illustration. They are not dissertations complete in themselves and extraneous to the verse, as they so often become in the later poems. In The Economy of Vegetation there is a marked shift of interest and emphasis; one often feels that the poetical allusion has been introduced for the sake of the prose explanation, and the reader's attention is continually divided, distracted and diverted. The Loves of the Plants, on the other hand, has as much unity as the scheme and the subject allow; and once the basic principles of the Linnaean system have been

(1) L.P. IV. 1.137, n.

grasped, it is possible to read the poem without reference to the notes, if the reader so wishes, and to miss nothing of fundamental importance.

The poem itself is a pleasing tour de force, though in the passage of time it has inevitably lost much that constituted its strongest appeal to Darwin's contemporaries. In its period the novelty of the idea, the wealth of topical and personal allusion, the variety of reference to current books and publications, and its direct reflection of popular interests and tastes, must have made the reading of it an exciting experience. Now the face of botany is changed; Linnaeus is no longer a name to conjure with, outside the circle of historians of science; personalities then dominant have become but names; and the eighteenth century's literature of science and travel has lapsed into obscurity. And most important of all, another poetic tradition has come between Darwin and ourselves, and we expect of poetry more than he can give. Horace Walpole, however, writing to "the Miss Berrys" in April, 1789, could say;

> "In the mean time I send you the most delicious poem upon earth. If you don't know what it is all about, or why, at least you will find glorious similies about everything in the world, and I defy you to find three bad verses in the whole stack.....I can read this over and over again for ever; for though it is so excellent, it is impossible to remember anything so disjointed, except you consider it as a collection of short enchanting poems, - as the Circe at her tremendous devilries in a church; the intrigue of the dear nightingale and rose; and the description of Medea; the episode of

> Mr.Howard, which ends with the most sublime of lines - in short, all, all; all is the most lovely poetry. And then one sighs, that such profusion of poetry, magnificent and tender, should be thrown away on what neither interests nor instructs, and, with all the pains the notes take to explain, is scarce intelligible."[1]

Walpole's objection to scientific instruction is no doubt that of the literary man. As a man of letters, his admiration for the work is unequivocal. Nor was he alone in his approbation. William Hayley, and his more distinguished friend William Cowper, both addressed complimentary poems to the author of The Botanic Garden.[2] Richard Polwhele, too, wrote to Darwin;

> ".... where'er with life creation teems,
> I trace thy spirit through the kindling whole;
> As with new radiance to the genial beams
> Of Science, isles emerge, or oceans roll,
> And Nature, in primordial beauty, seems
> To breathe, inspired by thee, the PHILOSOPHIC SOUL!"[3]

The reference here is primarily to The Economy of Vegetation, for the poem was written in 1792. Polwhele's The Unsex'd Females, published in 1798, contains some sharp satire upon the new fashion for botanical study among the female sex, and some pointed references to The Loves of the Plants. But his admiration for Darwin's poetical skill is still unbounded. He says;

---

(1) The Letters of Horace Walpole. ed. Peter Cunningham. 1861. Vol.IX. p.178.
(2) Included in the 1795 (3rd) edition of The Economy of Vegetation.
(3) Included in the 1795 edition of The Economy of Vegetation.

"In composing his Botanic Garden, Dr.Darwin was aware, that though imagination refuse to enlist under the banner of science, yet science may sometimes be brought forward, not unhappily, under the conduct of imagination: and of the latter, if I am any way a judge, we are presented with a complete specimen in that admirable poem. With respect to the structure of the poem, we have been told, that it wants connexion - that there is a reciprocal repulsion between the scientific and imaginative particles, and so little affinity even between the latter, that they cannot possibly cohere. But on this topic, let us hear the Author himself; who invites us to contemplate in his poem, "a great variety of little pictures, connected only by a slight festoon of ribbons". And they are pictures glowing in the richest colours.... the most beautiful, in short, that were ever delineated by the poetic pencil. I defy any one of Dr.Darwin's censurers, to point out a single picture, which is not finished with touches the most exquisite - 'with all the magic charms of light and shade'."1

This eulogy, it should be noticed, was published in the same year as The Loves of the Triangles, a work which damaged but did not kill Darwin's reputation. When Crabbe published his Parish Register in 1807, The Loves of the Plants was still worth a slightly scathing reference:

"Not Darwin's self had more delight to sing
Of floral courtship, in th' awaken'd Spring,
Than Peter Pratt, who simpering loves to tell
How rise the Stamens, as the Pistils swell;
How bend and curl the moist-top to the spouse,
And give and take the vegetable vows;
How those esteem'd of old but tips and chives,
Are tender husbands and obedient wives;
Who live and love within the sacred bower,-
That bridal bed, the vulgar term a flower."2

---

(1) Richard Polwhele. The Unsex'd Females. 1798. p.4.
(2) George Crabbe. The Parish Register. 1807. Part I. See The Poetical Works of George Crabbe. Ed. A.J.Carlyle and R.M. Carlyle. Oxford. 1908. p.58.

It was the Romantic movement which struck the death-blow. In a lecture delivered in 1811 Coleridge declared that in *The Botanic Garden* "there are not twenty images described as a man would describe them in a state of excitement."[1] His judgement was that

> "The poem is written with all the tawdry industry of a milliner anxious to dress up a doll in silks and satins",[2]

And no one has since seen fit to restore Darwin to the position he enjoyed in his own short day. Nor would this be possible. But looking back over a hundred and fifty years, we can understand why Darwin's success was immediate, and why it was transitory. We can even recapture something of the excitement with which *The Loves of the Plants* was first received.

---

(1) S.T. Coleridge. *Lectures and Notes on Shakspere and other English Poets*. Ed. T. Ashe. (Bohn.) 1885, p.48.
(2) Ibid.

THE TEMPLE OF NATURE

Darwin's last work, The Temple of Nature; or, the Origin of Society: a Poem, with Philosophical Notes, was published in 1803, a year after the death of its author, and when his brief reputation was already in its decline. It created little stir, and was soon forgotten. Its descent into obscurity was not only the result of changing fashions and the harm done by The Loves of the Triangles. The poem itself has little of the superficial attraction of The Botanic Garden. There is little that is fresh or significant in the way of poetic ornament, episode or description; much material has been transferred, without improvement, from the earlier poem; and the verse is often elliptical to the point of difficulty. Darwin's earlier aims, to write to the eye, to entertain the reader, have given way to a more severe didactic purpose, with the result that the verse contains much that is not poetry in its own right, but merely allusion to scientific theory contained in the notes, and, even worse, in the prose works, the Zoonomia and Phytologia. Darwin was apparently unconscious of this shift of emphasis. In the Preface to the poem he says:

> "The Poem, which is here offered to the Public, does not pretend to instruct by deep researches of reasoning; its aim is simply to amuse by bringing distinctly to the imagination the beautiful and sublime images of the operations of Nature in the order, as the Author believes, in which the progressive course of time presented them."[1]

The images, however, which he presents in the verse, depend too closely on detail of fact and theory, to awaken any immediate response in the reader. The subject-matter, moreover, involves much that would be incomprehensible to those uninstructed in the biological sciences, in philosophy, psychology and aesthetics. Darwin covers several fields of highly specialised knowledge, and the poetry becomes intelligible only when the knowledge has been acquired, and does nothing to convey it clearly to the reader. Indeed, the task was an impossible one, particularly in a poem of four short cantos.

The work is constructed on a more definite plan than either of the earlier poems. The first canto, entitled Production of Life, contains an account of the manner in which Darwin believed life to have originated, and an outline of his theory of evolution. Both these subjects had been fully dealt with in the Zoonomia; and the new treatment consists largely of a recapitulation, in verse and notes, of the earlier statements, together with some later

---

(1) T.N. Preface.

development and modification. The second canto, Reproduction of Life, deals with the maintenance and renewal of life by reproduction, and the evolution of different modes of organic reproduction, and is again based closely on the Zoonomia, and also on the Phytologia. The third canto, Progress of the Mind, contains Darwin's theory of psychology and aesthetics, repeated, once more, partly from the Zoonomia and partly from the Interludes of The Loves of the Plants. It explains the development of the human mind and its achievements. The last canto, Of Good and Evil, is a justification, not of the ways of God to man, but of the apparent cruelty of natural forces, and shows that everything in nature is for the best. The substance of this canto, too, had already appeared in prose form, in the Zoonomia and Phytologia. The whole work, as its sub-title indicates, represents the evolution of human society from its earliest beginnings, and relates its present structure to its origins.

The machinery of the poem is explained in the Preface:

> "In the Eleusinian mysteries the philosophy of the works of Nature, with the origin and progress of society, are believed to have been taught by allegoric scenery explained by the Hierophant to the initiated, which gave rise to the machinery of the following Poem."[1]

The idea was derived from the Divine Legation of William Warburton, of which Darwin had made extensive use

---

(1) Ibid.

in constructing his theory of the Portland Vase, and with which he was therefore well-acquainted. Warburton had explained that the Greater Mysteries of Eleusis had revealed to the initiate the errors of polytheism and the existence of "a supreme cause of all things", "the creator of the universe, who pervaded all things by his virtue, and governed all by his Providence".[1] The hierophant taught that Jupiter, Mercury, Bacchus and the other deities were not gods, but mortals, benefactors of mankind, deified in earlier ages by a grateful posterity. This was a common mode of interpreting ancient mythology at the time when Warburton was writing, and Darwin adopts the idea for his poem, and extends it to include what he considers the Hebrew mythology. In the Preface he explains:

> "The Deities of Egypt, and afterwards of Greece, and Rome, were derived from men famous in those early times, as in the ages of hunting, pasturage and agriculture. The histories of some of their actions recorded in Scripture, or celebrated in the heathen mythology are introduced, as the Author hopes, without impropriety into his account of those remote periods of human society."[2]

The origin and progress of the Mysteries, their conduct, ceremonies and rites, had been described by Warburton, De St.Croix, and other writers.[3] Darwin places the Temple of Nature upon the site of Paradise, the "cradle of the World"[4]

---

(1) William Warburton. The Divine Legation of Moses. 1738-41. (4th ed. 1755-88. Vol.I. Part I. pp.154-55.)
(2) T.N. Preface.
(3) See above, Wedgwood, Friend of Art.
(4) T.N. I. 1.36.

and original home of the human race, and the place upon which grew the tree of the knowledge of good and evil. In the midst of the temple stands the symbolic figure of Nature, with a hundred hands and a hundred breasts, and wearing a mural crown. Darwin's Nature probably derives from the idea of "rerum natura creatrix" or Venus physica present in the invocation to Venus in the opening lines of De Rerum Natura, from the Earth Mother, or Cybele, described later in Lucretius's poem,[1] as well as from the Demeter of Eleusis. That she represents life, the creative and sustaining power, is indicated by the quotation on the title-page of the poem of the following lines from the sixth book of Vergil's Aeneid:

> "Unde hominum pecudumque genus, vitaeque volantum,
> Et quae marmoreo fert monstra sub aequore pontus?
> Igneus est illis vigor, & caelestis origo.
> Virg.Aen.VI.728"

Darwin was probably not overmuch concerned with the Epicurean philosophy expounded by Lucretius, though he may well have taken De Rerum Natura as a model for a poem which was to deal with the origins of the world, of life, and of man. The sixth book of the Aeneid, however, had been demonstrated by Warburton to be an allegorical representation of the Eleusinian Mysteries,[2] which included the teaching of the doctrine of metempsychosis described by

---

(1) Lucretius. De Rerum Natura. Bk.II. ll.600-660.
(2) Warburton, op.cit., Vol.I. Part I. p.210ff.

Vergil in this book; so that the quotation from Vergil refers directly to the machinery of the poem, as well as to the conception of the power of life.

The Temple itself seems to owe something to Pope's Temple of Fame. There are occasional echoes of phrase, which suggest that this is so.[1] The Muse, invoked in the opening lines of the poem, is admitted with her train of Loves and Graces through the walls of the Temple, from which the profane are dismissed. The Hierophant is Urania, Priestess of Nature; and she reveals the mysteries of the production and reproduction of life, the progress of the mind, and discourses upon good and evil. The muse addresses her thus:

"FIRST, if you can, celestial Guide! disclose
From what fair fountain mortal life arose,
Whence the fine nerve to move and feel assign'd,
Contractile fibre, and ethereal mind:

How Love and Sympathy the bosom warm,
Allure with pleasure, and with pain alarm,
With soft affections weave the social plan,
And charm the listening Savage into Man."[2]

Urania's reply constitutes the main body of the poem, which will now be considered under headings corresponding to the four cantos. The first canto, which contains much complex biological theory, has been treated at somewhat greater length than the other three, both for the sake of clarity, and also as an illustration of Darwin's mode of thought.

---

(1) See. T.N.I. 1.67; 1.74; 11.79-82; and cf. The Temple of Fame, 1.62; 1.137; 11.147-48; etc.(The Poetical Works of Alexander Pope. ed.A.W.Ward. Globe Edition.1930.pp.113-24). It seems possible that Darwin may also have recollected the description of the home of Venus in Claudian's Epithalamium de Nuptiis Honorii Augusti, since he had used a quotation from this poem on the title-page of The Loves of the Plants. See Claudian.Loeb. 1922.pp.247-49. [Vol. I

(2) T.N. I. 11.215-22.

THE PRODUCTION OF LIFE

The theory of the origin of life which Darwin advances in The Temple of Nature is based directly on material contained in his medical treatise, the Zoonomia. This work, of which a third and corrected edition had been issued in 1801, included a statement of belief in an evolution of organic forms, and the statement is repeated in brief in the first canto of the poem. The two theories, that of the origin of life and that of evolution, are closely connected; and if their full significance is to be grasped, The Temple of Nature must be read in conjunction with the Zoonomia. For the first canto of the poem, and other relevant parts, form no more than a summary, sometimes in itself obscure, of the whole body of thought.

Darwin begins by placing the whole structure on a firm foundation of piety, since orthodoxy cannot be his. Urania explains:

> "GOD THE FIRST CAUSE! - in this terrene abode
> Young Nature lisps, she is the child of God.
> From embryon births her changeful forms improve,
> Grow, as they live, and strengthen as they move."[1]

Here, at the outset, is a declaration of belief in an evolutionary development. There follows a recapitulation

---

(1) T.N.I.11.223-26. See 1.223, n, and cf. Zoonomia. Vol.I. 1794 (2nd ed. 1796, p.109).

of the theory of the earth's origin which Darwin had expounded in full in The Economy of Vegetation.[1] In the earlier work, it will be remembered, it was explained that life began beneath the sea. In The Temple of Nature this idea is elaborated:

> "ORGANIC LIFE beneath the shoreless waves
> Was born and nurs'd in Ocean's pearly caves;
> First forms minute, unseen by spheric glass,
> Move on the mud, or pierce the watery mass;
> These, as successive generations bloom,
> New powers acquire, and larger limbs assume;
> Whence countless groups of vegetation spring,
> And breathing realms of fin, and feet, and wing."[2]

Every living thing, including man, who "styles himself the image of his God",[3]

> "Arose from rudiments of form and sense,
> An embryon point, or microscopic ens!"[4]

This is the central theme of the canto. A note on these last lines explains:

> "The arguments showing that all vegetables and animals arose from such a small beginning, as a living point or living fibre, are detailed in Zoonomia, Sect.XXXIX. 4.8. on Generation."[5]

In the earlier part of the section on Generation to which he refers Darwin develops his own theory of the manner of reproduction of animals and plants, a subject of argument throughout the eighteenth century. He believes that the

---

(1) E.V. I. 11.97-114 and II. 11.11-20 and 33-38.
(2) T.N. I. 11.295-302.
(3) T.N. I. 1.312.
(4) T.N. I. 11.313-14.
(5) T.N. I. 1.314, n.

rudiment of the embryon is secreted from the blood of the male and consists of a single living filament possessed of certain capabilities of development. The filament is received by the female, who supplies nourishment, warmth, and the means of respiration, but who does not provide any part of the embryon itself. All animals "have a similar cause of their organization, originating from a single living filament."[1] This theory, by analogy, leads to the suggestion that perhaps all animals and plants are derived from a single original filament endued with animality by the Great First Cause. Several arguments are put forward in support of this hypothesis. First, there are the developments exhibited by animals within the life-history of the individual, such as that from caterpillar to butterfly; secondly, changes induced by artificial cultivation, as in horses, dogs and sheep; thirdly, the accidental changes produced during the embryonic state, giving rise to "monsters", whose peculiarities are handed on to their descendants; fourthly, there is the similarity of structure evident in warm-blooded animals, birds, and amphibious creatures: and fifthly transformations in individuals and species which Darwin imagines to be brought about by desire

(1) Zoonomia. Vol.I. 1794. (2nd ed. 1796. p.503).

and exertion, such as the acquisition of organs particularly adapted for attack or defence. All this, Darwin thinks, points to divergence from an original common form. So he sums up:

> "From thus meditating on the great similarity of the structure of the warm-blooded animals, and at the same time of the great changes they undergo both before and after their nativity; and by considering in how minute a portion of time many of the changes of animals above described have been produced; would it be too bold to imagine, that in the great length of time, since the earth began to exist, perhaps millions of ages before the commencement of the history of mankind, would it be too bold to imagine, that all warm-blooded animals have arisen from one living filament, which THE GREAT FIRST CAUSE endued with animality, with the power of acquiring new parts, attended with new propensities, directed by irritations, sensations, volitions, and associations; and thus possessing the faculty of continuing to improve by its own inherent activity, and of delivering down those improvements to its posterity, world without end!"[1]

A little further on he exclaims:

> "What a magnificent idea of the infinite power of THE GREAT ARCHITECT! THE CAUSE OF CAUSES! PARENT OF PARENTS! ENS ENTIUM!"[2]

This is probably designed as an indication that the author is on the right side of morality and order, rather than as an expression of religious fervour. Although Darwin had nothing to fear but opinion, opinion in certain quarters was already against him, as the result of his

---

(1) Ibid., p.509.
(2) Ibid., p.513. The idea was not new. It had been put forward by Moreau de Maupertuis and Diderot. See. A.O. Lovejoy. <u>Some Eighteenth Century Evolutionists</u>. <u>Popular Science Monthly</u>. 1904. p.238ff. and p.323ff.

support of the French Revolution. And the expression of views so obviously at variance with orthodox religious teaching would tend to make him still more suspect, without the addition of some qualifying statement. Praise of the Great Architect commits him to nothing; but it may have had a reassuring ring for the upholders of design and the teleological principle. The section on Generation is concluded on a similar note:

> "As every cause is superior in power to the effect, which it has produced, so our idea of the power of the Almighty Creator becomes more elevated and sublime, as we trace the operations of nature from cause to cause, climbing up the links of these chains of being, till we ascend to the Great Source of all things.
>
> Hence the modern discoveries in chemistry and in geology, by having traced the causes of the combinations of bodies to remoter origins, as well as those in astronomy, which dignify the present age, contribute to enlarge and amplify our ideas of the power of the Great First Cause. And had those ancient philosophers, who contended that the world was formed from atoms, ascribed their combinations to certain immutable properties received from the hand of the Creator, such as general gravitation, chemical affinity, or animal appetency, instead of ascribing them to a blind chance; the doctrine of atoms, as constituting or composing the material world by the variety of their combinations, so far from leading the mind to atheism, would strengthen the demonstration of the existence of a Deity, as the first cause of all things; because the analogy resulting from our perpetual experience of cause and effect would have thus been exemplified through universal nature.
>
> The heavens declare the glory of GOD, and the firmament sheweth his handywork! One day telleth another, and one night certifieth another; they have

neither speech nor language, yet their voice is gone forth into all lands, and their words into the ends of the world. Manifold are thy works, O LORD! in wisdom hast thou made them all. Psal. XIX. CIV."(1)

This was a quotation favoured by the orthodox. The whole passage, too, anticipates and answers possible reproaches of atheism, since it sets its author against Epicurus, Lucretius and later atomists; and it links the new theory to the familiar idea of the Chain of Being. The impression of the work on the reader's mind is thus softened by an assurance of good faith and of adherence to piety and morality. Darwin has been called a Deist. He was not a Deist in the sense that he habitually asserted the religion of nature, and its independence of revelation. Indeed, this phase of thought had had its day long before Darwin came to write. The title has presumably been conferred on him by virtue of these declarations in the Zoonomia, and similar ones in the notes to the poems, but how far these were felt as a profession of faith and how far they were devised as concessions to expediency, it is difficult to say. As regards Darwin's religious beliefs, or lack of them, Mrs Schimmelpenninck tells us that,

"Dr. Darwin often used to say, 'Man is an eating animal, a drinking animal, and a sleeping animal, and one placed in a material world, which alone furnishes all the human animal can desire. He is gifted besides with knowing faculties, practically to explore and to

(1) Ibid., p.537.

> apply the resources of this world to his use. These are realities. All else is nothing; conscience and sentiment are mere figments of the imagination. Man has but five gates of knowledge, the five senses; he can know nothing but through them; all else is a vain fancy, and as for the being of a God, the existence of a soul, or a world to come, who can know anything about them?"[1]

Mrs.Schimmelpenninck was twelve years old at the time when Darwin is supposed to have made these remarks. Furthermore she was a prejudiced witness. It is true, nevertheless, that Darwin did frequently insist on the resources of this world, without reference to a future one, and Anna Seward reports that her friend Mr.Fellowes, "the eminent champion in our day, of true and perfect Christianity"[2] said of the doctor:

> "... he was acquainted with more links in the chain of <u>second</u> causes than had probably been known to any individual, who went before him; but that he dwelt so much, and so <u>exclusively</u> on second causes, that he too generally seems to have forgotten that there is a first."[3]

Miss Seward did not realise that she and Dr.Darwin did not, and could not, mean the same thing when they spoke of a first cause. Locke, Berkeley and Hume ruled the intellectual world in which Darwin lived, and philosophical scepticism was the air he breathed. He was widely read in

(1) <u>The Life of Mary Anne Schimmelpenninck</u>. 1858. Vol.I. p.241. Mrs. Schimmelpenninck was the daughter of Samuel Galton, friend of Darwin and member of the Lunar Society.
(2) Anna Seward. <u>Memoirs of the Life of Dr.Darwin</u>. 1804. p.91.
(3) Ibid., p.92.

every branch of contemporary science, including the new geology, which had destroyed the authority of the scriptures as a record of fact, and a rudimentary anthropology. For him, the basis of Christianity as a faith had crumbled, and he had nothing to put in its place. He lived in an age of reason, and he could not lose himself in a mystery. His mind was practical, focussed in the main upon objects and facts, and he did not feel the need of an outlet for personal emotion. Nor was there any confusion in his mind between religious experience and morality. For him, the Church represented superstition and repression; its ritual and symbolism meant little to him, for he was too close to the main issue between truth and falsehood as he saw it, and he looked elsewhere for satisfaction of his love of beauty in colour, form and words. He was limited by the intellectual milieu in which he had grown up, and by his own mind and temperament, to a scepticism which was practical, rather than purely philosophical. His mind was not an instrument sufficiently keen and delicate to enable him to excel in abstract speculation, and although his mental attitude bears the stamp of Hume's teaching, he is quite prepared, for all practical purposes, to accept a real world existing outside the senses and known through them, and a chain of causes which necessarily has a first cause. His chain must be linked to something; his progressive world cannot exist in a void; and the idea of an Ens Entium bestows a pleasing unity upon his whole conception of the universe. He bound himself to no creed that came within the limits of a formal religion, but it may well be that he found some satisfaction in the contemplation of an infinite and remote Cause of Causes. The most scientific and practical mind may have its sense of wonder, and Darwin had a wide, if not a profound, capacity for feeling. In any case, his lack of religion was not an irresponsible iconoclasm. He was a scientific humanist, and the Cause of Causes perhaps provided a fixed point, to which his belief in and his aspirations for the human race could be attached.

Darwin's theory of the production of life and of its subsequent evolution must be considered against the background, indicated above in broad outline, of his philosophical and religious position. The direct source of most of the detail of the theory was Buffon's Natural History, the major part of which was published between 1749 and 1788, the year of Buffon's death. Darwin's belief that all animals are related in structure, that all, including man, are derived from a common ancestor, is clearly derived from the Natural History. In Buffon's work, however, these opinions could not be given formal and systematic expression, since they were opposed to the teaching of the Church, which exercised a powerful censorship of science. His theory is therefore scattered throughout the work in the form of suggestion, hint, and hypothesis. He builds up an argument to an inescapable conclusion, and then retreats from his position with the remark that the apparent facts cannot be true, since they contradict Holy Writ. Always he gives formal assent to the truth of the book of Genesis, and for the rest the reader must look between the lines. On those occasions when he overstepped the bounds of discretion he was obliged to retract and to declare his complete adherence to the doctrines of the Church. He nevertheless contrived to say much that was original and significant. Darwin, who followed him closely, was more fortunate in being able to express the same ideas without fear of the consequences, and therefore more fully and clearly.

One of the best examples of Buffon's method is his article on the ass,[1] which follows that on the horse, the first animal, after man, to be described. He points out the similarity of skeletal structure and organs in the two animals, and then suggests that it almost looks as though the ass, as the result of the influence of climate and food, and by slight successive deviations,

---

(1) Buffon. Oeuvres Complètes. Paris. 1878. Vol.III. p.565.

has merely degenerated from the horse, and cannot be considered a distinct species. He then declares that this theory presents certain difficulties, since if this kind of comparison is extended, it will be seen that the skeleton of man, with some slight rearrangement, closely resembles that of the horse, and that this similarity of structure may be traced throughout the quadrupeds, birds, reptiles and fish. If, therefore, the principle of degeneration of species is once admitted, there is no reason why all species should not have degenerated from a common ancestor. This is Buffon's central belief and Darwin's starting point. Buffon, however, may go no further, and must draw back from the edge of the precipice. Thus he declares;

> "Mais non: il est certain, par la révélation, que tous les animaux ont également participé à la grâce de la création; que les deux premiers de chaque espèce et de toutes les espèces ont sortis tout formés des mains du Créateur, et l'on doit croire qu'ils étaient tels alors, à peu près, qu'ils nous sont aujourd'hui représentés par leurs descendants."[1]

The ass is therefore an ass, and not a degenerated horse. The pig, the sheep, the dog, and the monkey are treated in the same way. Obliquely attacking the teleological principle, Buffon points out that the pig is possessed of certain imperfectly formed and therefore useless organs.[2] He remarks upon the modifications

(1) Ibid., Vol.III. p.567.
(2) Ibid., Vol.III. p.603.

effected in the wild stock of sheep and dogs by domestication and selective breeding.[1] And he notes the close resemblances between the orang-outang and man.[2] Gradually he builds up a picture of one species rising out of another, the changes effected, over many generations, by variation of environment and by man's domestication of wild species. He never commits himself to an unequivocal statement, nor does he enter into the question of the manner in which this adaptation to environment takes place. His main concern is to establish the fact of development and relation of species. Theories of the proximate causes of change are left for others to elaborate, Darwin among them.[3]

Buffon was not the only scientist to meditate upon the question. He was simply the first to state it, as clearly as he was allowed, in all its main aspects. His work illustrates a change of attitude towards natural history which was taking place gradually during his century, and which Professor Lovejoy has termed the temporalizing of the Chain of Being.[4] During the seventeenth and early eighteenth centuries there had grown up a conception of a scale of beings, graduated from the lowest and simplest

---

(1) Ibid., Vol.III. p.590 and p.621.
(2) Ibid., Vol.IV. p.695.
(3) See below, p.356 ff.
(4) Arthur. O. Lovejoy. The Great Chain of Being. Harvard University Press. 1942. Lecture IX. The Temporalizing of the Chain of Being.

forms of life, through the whole animal creation, up to man, and then, in all probability extending upwards through ever higher degrees of intellectual beings, dwelling, according to some, on other planets, to others existing only in the world of spirits. The scale was continuous and gradual, and represented every possible form of being.[1] Basically the conception was a religious one. Furthermore, since man occupied, not the highest place in the scale, but only the connecting position between the brute creation and the purely intellectual beings, it followed that his relation to the lower forms of creation received as much emphasis as his superiority to them; and while the Chain of Being remained a purely religious and philosophical conception, this was considered right and salutary. When, however, the chain came to be examined scientifically, and man's relationship to the lower animals became defined more closely and realistically, what had formerly been a desirable check on human pride became a danger to the established order of belief. Hence the suspicion with which Buffon was regarded.

---

(1) Two well known expositions of the idea are: Addison. Spectator for Oct. 25, 1712, (No.519). See The British Essayists. Ed. James Ferguson. Vol.XI, pp.202-203; Pope. Essay on Man. Epistle I. ll.233-246. See The Poetical Works of Alexander Pope. ed. A.W. Ward. (Globe Edition) 1930. pp.198-199.

Several scientific developments had contributed to the temporalizing of the Chain. During the seventeenth century various attempts had been made to organise knowledge of animals and plants, and various systems of classification had arisen, and divided the kingdom of nature into classes, orders, genera and species. In the following century the method was developed to its fullest extent in the Systema Naturae of Linnaeus. Emphasis was thus placed on resemblances and differences between similar organisms, and interest was concentrated at two particular points in the scale, as Professor Lovejoy has explained.[1] On the one hand, the development of the microscope had revealed a new world of minute organisms of a simplicity greater than any hitherto suspected; and on the other, voyages of discovery had brought about a general realisation that the higher types of brute animal were removed at a lesser distance from man than had formerly been imagined, since man in his primitive state was himself little more than an animal. The main problem was now the nature of the relationship between man and the apes. Were the two species separate links in a chain whose constitution had been immutably determined at the creation, or was the one form a development from the other? And given the possibility

(1) Lovejoy, op.cit., p.233.

of this development, as Buffon saw, the whole Scale of Being became, not a static order of things, but a temporal progression. Each link in the chain might represent an improvement on the previous one and a step towards the next one. This implied an emergence of intellect through lower manifestations of sentience, deriving ultimately from microscopic organisms which it was difficult to distinguish definitively from inorganic matter.

The microscope had come into use as an aid to scientific research during the seventeenth century. One result of this was an immediate extension of the knowledge of the anatomy of plants and of the smaller animals. Robert Hooke and Antony von Leeuwenhoek, a native of Delft who sent the results of his researches to the Royal Society, were the first to describe minute freshwater animals, all but invisible to the naked eye, and specimens of unicellular organisms never before seen, and now known as the protozoa. The discovery of the microscopic animalcules, as they came to be called, aroused much interest, partly because it seemed to confirm and extend the established idea of the Chain of Being, partly because it could be used to explain a theory as old as Aristotle, and never yet satisfactorily demonstrated, that of spontaneous generation. Every naturalist, before the seventeenth century, believed that maggots and flies could arise spontaneously in decaying organic matter; and the new microscopic animalcules seemed to provide the link between corrupt matter and the complex organisms to which it was supposed to give birth. In 1668, however, Francesco Redi, of Florence, published a set of experiments which proved that if all living causes were excluded, no living things arose. Redi believed that the worms found in meat were derived, not from putrefying matter, but from flies. He therefore put meat in several flasks, some of which were closed and sealed, other left open. Flies were seen to enter and leave the open flasks, and in due course worms were found in the meat they contained. The meat in the sealed flasks contained no flies, although it was putrid. Redi thus demonstrated conclusively that worms could not arise in decaying flesh by spontaneous generation. A heated and long drawn out controversy now arose, as to whether microscopic animalcules could arise spontaneously or not. On the one hand it was shown that by boiling, protecting or chemically treating the medium, the appearance of organisms was prevented. On the other hand it was repeatedly demonstrated that organisms could and did appear in a medium so treated. Eventually the problem resolved itself into a debate between John Needham, an English Catholic priest who became a friend of Buffon, and

Lazzaro Spallanzani, a distinguished Italian scientist. In 1748 Needham, in conjunction with Buffon, published a series of experiments similar to those performed by Redi. He boiled mutton broth and placed it in a phial, which was then corked and sealed. After a few days the phial was opened, and the broth was found to be swarming with animalcules. Needham therefore declared that they had been spontaneously generated. Spallanzani then provided an apparent refutation of Needham's conclusions, by means of other experiments, and the debate continued, not to be settled until the nineteenth century. When Buffon's <u>Natural History</u> was published spontaneous generation had become a bone of contention between free-thinking scientists and the religious of all sects. Buffon naturally accepted it; furthermore, he explained, at great length, how it came about.[1] And in due course his theory was adopted by Darwin. Buffon refers his readers to Needham's experiments, and explains that microscopic animalcules are formed from a congress of organic particles, set free from a decaying organism. The majority of these animalcules he adds, are without the power of reproduction. Many, too, are devoured by larger animals and never attain to any degree of development. From this he proceeds to a

(1) Buffon. <u>Oeuvres Complètes</u>. 1878. Vol.III. Chapters IV-IX.

suggestion of the manner in which life originated, expressed in the form of an unlikely hypothesis. He points out that spontaneous generation is the most general and frequent mode of generation; it is in fact the primary mode. If, by a stroke of Providence, every living organism should be simultaneously destroyed, there would be nothing to prevent a resurgence of the animal world by a gradual development from minute animalcules formed in the decaying bodies of the old world, by a combination of free organic particles.[1] He thus outlines a scheme of evolutionary development of organic forms from the lowest manifestation of life, a particle endowed with certain properties which distinguish it from inanimate matter. The particle, a purely theoretical entity, is the microscopic animalcule reduced to the utmost simplicity.

This is the background against which Darwin was working. He had nothing to do but to adapt the material provided by Buffon to his own purposes and theories, and we must now examine how this is done. He begins by describing in verse the two forces which govern inanimate matter, heat, which according to the theory of Lavoisier, was considered as a general repulsive power, existing between the particles of bodies and preventing them from

---

(1) Ibid., Vol.III. pp.119-121.

coalescing, and attraction, which was regarded as manifesting itself in two ways, as a general power of attraction, or gravity, and as a particular attraction, or chemical affinity. These two forces brought about the formation of the universe from the original chaos, and they control the formation of animal bodies. Both forces, according to current scientific theory, are regarded as the result of the action of imponderable fluids, or ethers.[1] Animate matter, however, is distinguished from inanimate, by its subjection to a third force, which Darwin describes as the power of contraction, in response to stimulus. Thus:

> "Last, as fine goads the gluten-threads excite,
> Cords grapple cords, and webs with webs unite;
> And quick CONTRACTION with ethereal flame
> Lights into life the fibre-woven frame.-"[2]

Contraction is explained in a footnote:

> "The power of contraction, which exists in organized bodies, and distinguishes life from inanimation, appears to consist of an ethereal fluid which resides in the brain and nerves of living bodies, and is expended in the act of shortening their fibres. The attractive and repulsive ethers require only the vicinity of bodies for the exertion of their activity, but the contractive ether requires at first the contact of a goad or stimulus, which appears to draw it off from the contracting fibre, and to excite the sensorial power of irritation."[3]

The ether of contraction, Darwin adds;

> ...."probably occasions the minute particles of the fibre to approach into absolute or adhesive contact, by withdrawing from them their repulsive atmospheres;"[4]

---

(1) See T.N. I. 11.235-42 and 1.235, n; 1.239, n.
(2) T.N. I. 11.243-46.
(3) T.N. I. 1.245, n.
(4) Ibid.

This is fairly clear, though the multiplication of ethereal fluids is obviously making for complications. When, however, he continues, in verse,

> "Hence without parent by spontaneous birth
> Rise the first specks of animated earth;"[1]

an immediate difficulty arises. He has just said that the ether of contraction resides in the brain and nerves of living bodies. The first specks of animated earth, by which he means microscopic animalcules, however, have neither brain nor nerves. The contradiction had appeared earlier in another form, in the <u>Zoonomia</u>,[2] and had not passed unnoticed by Thomas Brown of Edinburgh, who had published a criticism of the work, entitled <u>Observations on the Zoonomia of Erasmus Darwin, M.D.</u> Darwin had explained in the prose work that the power of contraction of animal bodies is the immediate result of an exertion of the spirit of animation, which is secreted from the blood by the brain. The brain thus acts as a gland. Brown had pointed out that the original production of the spirit of animation was therefore impossible, since the gland, in this case the brain, must already possess the power of being stimulated, or the spirit of animation, in order to be able to secrete.[3] The ether of contraction described

---

(1) T.N. I. ll.247-48.
(2) <u>Zoonomia</u>. Vol.I. 1796. p.10.
(3) Thomas Brown. <u>Observations on the Zoonomia of Erasmus Darwin, M.D</u>. 1798. p.2.

by Darwin in The Temple of Nature is evidently the spirit of animation of the Zoonomia, but must, in Darwin's theory of the production of life, be independent of the brain. The confusion no doubt arises from Darwin's eclectic habit of mind. He has attempted to combine two ideas in one comprehensive system, and he is content to ignore any discrepancies.

The idea of the power of contraction as the distinguishing characteristic of living matter was no doubt derived from the Elementa Physiologiae of the Swiss physiologist Haller,[1] which constituted one of the standard medical works of the later eighteenth century. Haller explained that a muscle fibre has a tendency to shorten as the result of any stimulus, and afterwards to expand again to its normal length. He called this capacity for contraction irritability. Darwin's "goad or stimulus", it will be remembered, both causes the exertion of the ether of contraction, and excites the sensorial power of irritation.

The spirit of animation, which had originated with Descartes, was a common conception of the time. It could not, however, be combined with the contractive power of the muscle fibre quite in the manner in which Darwin tried to do so. Descartes had postulated a certain subtle vapour

---

(1) 1759-66.

which passed from the blood into the nerves, and thence into the muscles, where it caused a distention and consequent shortening, or contraction. The idea was adopted by Boerhaave, and elaborated in his Institutiones Medicae,[1] with which Darwin must have been thoroughly familiar. The confusion in his mind between the spirit of animation and the ether of contraction probably arises out of a change, which took place between the publication of the Zoonomia and that of The Temple of Nature, in his view of the exact nature of the first living organism, the parent of all subsequent organisms. It was all connected with the vexed question of generation.

There were at this period two main theories of the reproduction of living things, and both involved the conception of "preformation", or "evolution" in the earlier sense of the word. One school of thought held that the embryo was contained in the egg, and that in impregnation no material substance was added by the male. Fertilisation was supposed to be the communication of a certain influence, which caused the already completely formed embryo to develop. And since the embryo in the egg was complete, it must contain ovaries, and eggs in the ovaries, and complete embryos in the eggs. This idea, extended indefinitely, meant that the embryo of every animal that

---

(1) 1708.

was to exist was contained within the egg of the first animal to be created, one within another, and awaiting only the influence of the male to allow of its development. The theory was thus known as "emboîtement"; and each embryo "evolved" in its turn. The opposing view was that the male contributed the actual embryo, which contained within itself all future generations of embryos, and which merely found a nidus, or place for development, in the female. During the eighteenth century, however, there were several attacks on the whole idea of preformation. The first of these came from Moreau de Maupertuis, who in 1745 put forward the theory, in his Vénus Physique that the embryo was formed by a union of organic particles derived from both parents, who contributed equal parts. Then, in 1759, Caspar Friedrich Wolff published his Theoria Generationis, in which he put forward a theory of epigenesis. He showed that the different organs of plants are developed from undifferentiated tissue at the tip of the growing root or shoot; that certain organs in the chicken are similarly developed from undifferentiated tissue; and that there could, therefore, be no preformation. The earlier theories were thus assailed at two points, and the question now was, first, whether the rudiments of the embryo were provided by the male or by the female, and secondly, how the rudimentary embryo developed into the fully formed animal.

Buffon took up the problem, and propounded the theory that the embryon was formed from a combination of organic particles provided by both male and female out of the superfluity of particles absorbed during the process of nutrition.[1] This was pure hypothesis, and Darwin did not adopt it in his Zoonomia, when this was first published in 1794. He declared that since the female provided nourishment, air and protection for the developing organism, she could hardly be expected to furnish half the embryo in addition.[2] The embryo was therefore secreted from the blood of the male, but it was not pre-formed:

> "I conceive the primordium, or rudiment of the embryon, as secreted from the blood of the parent, to consist of a simple living filament as a muscular fibre; which I suppose to be an extremity of a nerve of loco-motion, as a fibre of the retina is an extremity of a nerve of sensation; as for instance one of the fibrils, which compose the mouth of an absorbent vessel; I suppose this living filament, of whatever form it may be, whether sphere, cube, or cylinder, to be endued with the capability of being excited into action by certain kinds of stimulus. By the stimulus of the surrounding fluid, in which it is received from the male, it may bend into a ring, and thus form the beginning of a tube. Such moving filaments, and such rings, are described by those, who have attended to microscopic animalcula. This living ring may now embrace or absorb a nutritive particle of the fluid, in which it swims; and by drawing it into its pores, or joining it by compression to its extremities, may increase its own length or crassitude; and by degrees the living ring may become a living tube."[3]

This idea of the basic organic entity, endued with certain potentialities, may owe something to Maupertuis,

---

(1) Buffon. Oeuvres Complètes, 1878. Vol.III. Chapter IV.
(2) Zoonomia. Vol.I. 1796. p.488.
(3) Ibid., p.496.

who in his Système de la Nature, published in 1751, had explained that all the particles of which matter is composed are possessed of a certain degree of something resembling perception. In the particles which compose inanimate matter, this active property, or "perception", would be very slight; in the lowest living creatures it would be a little more acute, and so on. Maupertuis says carefully:

> "La Religion nous défend de croire que les corps que nous voyons doivent leur premiere origine aux seuls loix de la Nature, aux propriétés de la matiere. Les divines Ecritures nous apprennent comment tous ces corps furent d'abord tirés du néant, & formés; & nous nous sommes bien éloignés d'avoir le moindre doute sur aucune des circonstances de ce récit."[1]

Nevertheless, God might have endowed the particles which composed the first created beings with certain properties:

> ".....s'il a doué chacune des plus petites parties de la matiere, chaque élément, de quelque propriété semblable à ce que nous appellons en nous désir, aversion, mémoire; la formation des premiers individus ayant été miraculeuse, ceux qui leur ont succédé ne sont plus que les effets de ces propriétés. Les élémens propres pour chaque corps se trouvant dans les quantités suffisantes, & dans les distances d'où ils peuvent exercer leur action, viendront s'unir les uns aux autres pour réparer continuellement les pertes de l'Univers."[2]

Darwin, who had no need of scruples about casting doubt on the book of Genesis, might well have found in this the germ of his own theory. The capability of response to stimuli, possessed by his simple living filament, corresponds

---

(1) Pierre Louis Moreau de Maupertuis. Oeuvres. 1768. Vol.II. p.154.
(2) Ibid., Vol.II. p.157.

to some extent to the "perception" of the particles of Maupertuis. Since this filament consists of the extremity of a nerve of locomotion, or muscular fibre, it possesses irritability or the power to contract in response to stimuli. As the embryo develops by the accretion of new parts, it acquires further powers:

> "With this new organization, or accretion of parts, new kinds of irritability may commence; for so long as there was but one living organ, it could only be supposed to possess irritability; since sensibility may be conceived to be an extension of the effect of irritability over the rest of the system."[1]

In response to these new irritabilities and sensibilities, new organs are formed, which in turn possess their own irritabilities and sensibilities, and lead to further development, until the animal is complete. Darwin has apparently forgotten that he has defined irritability and sensibility as different modes of operation of the spirit of animation, which is secreted by the brain. There is no way out of the difficulty, unless we accept the fact that the power of response to stimuli, or contraction, in the rudimentary organism, is different from that of the fibre of the fully developed organism. The rudiment of the embryo is evidently said to be a muscular fibre, in order that it shall have this power of contraction, and the exact relationship of this theory to the psychological system must not be pressed too closely.

---

(1) Zoonomia, Vol.I. 1796. p.496. For a definition of sensation, see p.32, and T.N. Add.Note II.

When we come to The Temple of Nature, however, we find that a theory of spontaneous generation, explained in a lengthy Additional Note,[1] has been substituted for the idea of one original living filament. It is based on a new theory of generation, which Darwin had developed after the publication of the Zoonomia. This was inserted in the third edition of 1801,[2] and in the Phytologia,[3] and is given in brief in The Temple of Nature. In the Additional note headed Spontaneous Vitality of Microscopic Animals Darwin explains that an embryo is produced by a conjunction of two types of particles; one kind, secreted by the male, possesses an appetency to unite, and the other, secreted by the female, a propensity to be united. He refers the reader to the full "experimental proof" set out in the Phytologia, and in the third edition of the Zoonomia. The whole idea is clearly based on Buffon's two sets, male and female, of organic particles, which he had formerly rejected. Buffon, moreover, had said that organic particles, released by putrefaction from combination in organised bodies, could combine spontaneously to form simple organisms. Darwin adopts this theory also. He points out that particles of dead organic matter are, by the process of nutrition, combined with animal and vegetable organs. Then:

---

(1) T.N. Add. Note. I.
(2) Zoonomia. 3rd ed. 1801. Appendix to Sect. XXXIX. Generation. Vol.II. p.277.
(3) Phytologia, 1800. Part I. Sect. VII. 3. 6-12.

"There hence appears to be an analogy between generation and nutrition, as one is the production of a new organization, and the other the restoration of that which previously existed; and which may therefore be supposed to require materials somewhat similar. Now the food taken up by animal lacteals is previously prepared by the chemical process of digestion in the stomach; but that which is taken up by vegetable lacteals is prepared by chemical dissolution of organic matter beneath the surface of the earth. Thus the particles, which form generated animal embryons, are prepared from dead organic matter by the chemico-animal processes of sanguification and of secretion; while those which form spontaneous microscopic animalcules or microscopic vegetables are prepared by chemical dissolutions and new combinations of organic matter in watery fluids with sufficient warmth."[1]

Thus particles of organic matter, not in themselves possessed of animation, could combine, in suitable conditions, to form a fibre, or microscopic organism, "which will contract when stimulated, and thus constitutes the primordium of life."[2] Haller's definition of irritability as the power of a muscular fibre to contract in response to a stimulus has now been used to define animation itself. All connection with the nervous system and the spirit of animation is severed, since microscopic organisms owe nothing to parent muscles, but the ether of contraction is retained, although it cannot, as Darwin defines it, account for the power of the rudimentary fibre to contract, and has no real relation to the theory of spontaneous generation.

---

(1) T.N. Add. Note I. p.6.
(2) Ibid., p.7.

There is, indeed, no reason why Darwin should retain the theory of the Zoonomia that all forms of life have arisen from a single original filament, since, given the possibility of spontaneous generation, it is far more likely that more than one filament should have arisen from pre-existing organic particles. And the organic particles must have existed previously, in order that the filament should be able to obtain nourishment. To have discarded the earlier theory completely, however, would have entailed a thorough revision of the Zoonomia, a formidable undertaking. Some compromise is attempted in the third edition of the work. Darwin remarks:

> "....I am now induced to believe, that the embryons of complicate animal and vegetable bodies are not formed from a single filament as above delivered; but that their structure commences in many parts at the same time, though it is probable, that the most simple or first exordium of animation was begun by a single filament, and continues to do so in the spontaneous production of the smallest microscopic animals, which do not appear to have been generated by other animalcula similar to themselves...."[1]

The whole question of spontaneous generation had always been a vexed one for those who held fast to belief in a special creation. Darwin is careful to make his own exposition of the theory sound as reassuring as possible. He says:

---

(1) Zoonomia. 1801. Vol.II. p.277.

"From the misconception of the ignorant or superstitious, it has been thought somewhat profane to speak in favour of spontaneous vital production, as if it contradicted holy writ; which says, that God created animals and vegetables. They do not recollect that God created all things which exist, and that these have been from the beginning in a perpetual state of improvement; which appears from the globe itself, as well as from the animals and vegetables which possess it. And lastly, that there is more dignity in our idea of the supreme author of all things, when we conceive him to be the cause of causes, than the cause simply of the events, which we see; if there can be any difference in infinity of power!"[1]

He then explains that it is not suggested that the larger animals might have been produced by this method, as Ovid has described. Spontaneous generation is to be looked for only "in the simplest organic beings, as in the smallest microscopic animalcules",[2] which, he believes, can enlarge and improve themselves by hourly reproduction. Nor is want of analogy any argument against the theory, since "the want of analogy opposes the credibility of all new discoveries".[3]

As evidence of spontaneous generation Darwin advances the experiments performed by Buffon and others on infusions of animal and vegetable matter in sealed phials. He explains that the animalcules formed in the phials are believed to possess the power of generating others like themselves by solitary reproduction; and adds that each generation enlarges and improves upon its predecessors.

---

(1) T.N. Add. Note I. p.1.
(2) Ibid., p.1.
(3) Ibid., p.2.

He refers the reader to a paper in the Philosophical Transactions for 1769, by John Ellis, entitled Observations on a particular Manner of Increase in the Animalcula of vegetable Infusions, etc.[1] Ellis had described the reproduction of various microscopic organisms by binary fission. Eels in paste, too, Darwin explains, "are viviparous, and produce at intervals a numerous progeny".[2] These creatures, found in flour and water paste, were one of the best known species of the animalcules, and one of the few to which Buffon attributed the power of reproduction. They were larger in size than most of those known. Furthermore,

> "These eels were probably at first as minute as other microscopic animalcules; but by frequent, perhaps hourly reproduction, have gradually become the large animals above described, possessing wonderful strength and activity."[3]

To Darwin, the evolution of organic forms is not an accomplished process. It still continues, and takes place perpetually, at least among the simplest living things.

He is anxious to contradict the notion, upheld by opponents of spontaneous generation, and particularly by Joseph Priestley, that microscopic animalcules are produced, not spontaneously, but from eggs floating in the atmosphere, and refers to an article in the Philosophical

---

(1) Vol.LIX. p.138.
(2) T.N. Add. Note I. p.3.
(3) Ibid., p.3.

Magazine for May 1800, in which a scientist called Girtanner attacked Priestley's theory.[1] He describes different types of animalcules from an article in The English Encyclopaedia,[2] a publication in ten volumes which had appeared in 1802, and this suggests that the Additional Note on Spontaneous Vitality was one of the last parts of The Temple of Nature to be completed, since Darwin died in April, 1802. He quotes, too, from O.F.Müller's Animalcula Infusoria Fluviatilia et Marina, published in 1786, in which the microscopic organisms then known had been described and arranged in classes.[3] Darwin gives Müller's classification in outline in an Appendix and concludes his article thus:

> "I hope that microscopic researches may again excite the attention of philosophers, as unforeseen advantages may probably be derived from them, like the discovery of a new world."[4]

Having established, as he believes, the fact of spontaneous generation, Darwin passes on to the manner in

---

(1) Philosophical Magazine. May, 1800. Vol.VI. p.351.
(2) The English Encyclopaedia. 1802. Vol.I. Art. Animalcule. (p.228).
(3) Müller's book includes a series of plates, some of them coloured, showing the organisms described in the text.
(4) T.N. Add.Note I. p.11. cf. the article in The English Encyclopaedia (2nd paragraph):
"By the help of magnifying glasses, we are brought into a kind of new world;......." See also Add. Note I.p.11, "......it is not so easy to view them as in water; which as it is transparent, the creatures produced in it can easily be observed by applying a drop to a microscope". And cf. The English Encyclopaedia. Vol.I., p.228.
".....but water being transparent, and confining the creatures in it, we are able, by applying a drop of it to our glasses, to discover, to a certain degree of smallness, all that it contains.-"

which the organisms so formed can increase in size, so that from the filament arising from a union of particles a more complex organism can grow; and here he follows the description of the development of the original living filament given in the Zoonomia and quoted in part above:

"In earth, sea, air, around, below, above,
Life's subtle woof in Nature's loom is wove;
Points glued to points a living line extends,
Touch'd by some goad approach the bending ends;
Rings join to rings, and irritated tubes
Clasp with young lips the nutrient globes or cubes;
And urged by appetencies new select,
Imbibe, retain, digest, excrete, eject."[1]

In the Zoonomia it had been explained that each muscular fibre "may be considered as a row or string of beads; which approach, when in contraction, and recede during its rest or elongation."[2] That is to say, the single filament is composed of a row of particles. And the whole body of a complex organism consists of an arrangement of filaments. Thus, "as all these filaments have possessed, or do possess, the power of contraction, and of consequent inertion or elongation; it seems probable, that the nutritive particles are applied during their times of elongation; when their original constituent particles are removed to a greater distance from each other."[3] The addition of particles is not haphazard; it is governed by the irritability of the filament, or its ability to select only those

(1) T.N. I. ll.251-58.
(2) Zoonomia. Vol.I. 1796. p.469.
(3) Ibid., p.469.

particles adapted to it. As the organism grows it develops new irritabilities, and so selects different kinds of particles for different particles, so that each part of the body takes up what is suited to its own development.[1] This is, in essence, Buffon's theory of nutrition, although Darwin insists that his particles are quite different from those of Buffon.[2] The "nutrient globes or cubes", at any rate, are derived from the French philosopher, who attributes the different densities of different substances to the shape of the particles or molecules of which they are composed.[3]

So, by the process of nutrition, the fully formed animal develops. So, Darwin explains, the land has been formed from the ocean, as he had described in The Economy of Vegetation.[4] And so, too, more complex forms of life have arisen, endowed with the mental powers of sensation, imagination, association and volition.[5] The outline of the progress of evolution is completed by a description of some of the most primitive forms of life, viewed through the microscope:

> ".... to our wondering eyes the focus brings
> Self-moving lines, and animated rings;
> First Monas moves, an unconnected point,
> Plays round the drop without a limb or joint;

---

(1) Ibid., p.468
(2) Ibid., pp.468-69.
(3) Buffon. Oeuvres Complètes. 1878. Vol.IV. p.369.
(4) T.N.I. ll.265-68 and l.268, n. cf. E.V.II. ll.33-38 and l.36, n.
(5) T.N. I. ll.269-280.

Then Vibrio waves, with capillary eels,
And Vorticella whirls her living wheels;
While insect Proteus sports with changeful form
Through the bright tide, a globe, a cube, a worm.
Last o'er the field the Mite enormous swims,
Swells his red heart, and writhes his giant limbs."[1]

These animalcules had been described by Linnaeus, Müller, and Henry Baker, whose two volumes, The Microscope Made Easy and Employment for the Microscope were well known to naturalists.[2] Much of the information given by these authors had been summarised, too, in the article Animalcula in The English Encyclopaedia, so that Darwin's scientific readers would be sure to be familiar with their names and forms. It was under such forms, Darwin explains, that, organic life began beneath the sea, and from such forms that man himself, and all inferior creatures, have arisen.[3] He now describes the process of evolution in more detail. He repeats the story of the formation of rocks from the remains of sea-animals, of the first volcano, and of the emergence of dry land from the ocean, from The Economy of Vegetation,[4] and refers the reader to the relevant Additional Notes in the earlier poem.[5] Then:

---

(1) T.N. I. ll.285-94.
(2) The Microscope Made Easy was published in 1743 and reached the fifth edition in 1769. See especially Employment for the Microscope. 1753. (2nd ed. 1764). Part II.
(3) T.N. I. ll.295-314.
(4) T.N. I. ll.315-26.
(5) T.N. I. l.319, n.

"In countless swarms an insect-myriad moves
From sea-fan gardens and from coral groves;
Leaves the cold caverns of the deep, and creeps
On shelving shores, or climbs on rocky steeps.
As in dry air the sea-born stranger roves,
Each muscle quickens, and each sense improves;
Cold gills aquatic form respiring lungs,
And sounds aerial flow from slimy tongues."[1]

A note explains:

> "After islands or continents were raised above the primeval ocean, great numbers of the most simple animals would attempt to seek food at the edges or shores of the new land, and might thence gradually become amphibious; as is now seen in the frog, who changes from an aquatic animal to an amphibious one; and in the gnat, which changes from a natant to a volant state.
>
> At the same time new microscopic animalcules would immediately commence wherever there was warmth and moisture, and some organic matter, that might induce putridity. Those situated on dry land, and immersed in dry air, may gradually acquire new powers to preserve their existence; and by innumerable successive reproductions for some thousands, or perhaps millions of ages, may at length have produced many of the vegetable and animal inhabitants which now people the earth."[2]

Darwin now turns to descriptive illustration. He gives examples of organisms which represent the stage at which life emerged from the waters. Thus Trapa, a plant, possesses both aquatic and aerial leaves;[3] the diodon, an amphibious animal, has both gills and lungs.[4] Some animals show, in the life-history of the individual, the history of the race, and among these are the frog and the mosquito.[5]

---

(1) T.N. I. ll.327-34.
(2) T.N. I. l.327, n.
(3) T.N. I. ll.335-42 cf. L.P. IV. ll.203-20 and l.204, n.
(4) T.N. I. ll.351-52.
(5) T.N. I. ll.343-50.

Each of the animals mentioned in the verse is described, mainly from Linnaeus, in footnotes and Additional Notes. One paragraph of this departs pleasantly from the factual:

> "Some amphibious quadrupeds, as the beaver, water rat, and otter, are said to have the foramen ovale of the heart open, which communicates from one cavity of it to the other; and that, during their continuance under water, the blood can thus for a time circulate without passing through the lungs; but as it cannot by these means acquire oxygen either from the air or water, these creatures find it frequently necessary to rise to the surface to respire. As this foramen ovale is always open in the foetus of quadrupeds, till after its birth it begins to respire, it has been proposed by some to keep young puppies three or four times a day for a minute or two under warm water to prevent this communication from one cavity of the heart to the other from growing up; whence it has been thought such dogs might become amphibious. It is also believed that this circumstance has existed in some divers for pearl; whose children are said to have been thus kept under water in their early infancy to enable them afterwards to succeed in their employment."[1]

This is derived from Buffon, who recounts[2] how he performed the experiments on puppies which Darwin describes. Of three puppies subjected to the treatment, only one died, but it was of course impossible to know whether it would have died or not if it had not been held under water. Buffon did not pursue the experiments, but suggested that by this method new species of amphibious animals might be obtained, and human divers much improved.

---

(1) T.N. Add. Note V. Amphibious Animals. p.18.
(2) Buffon. Oeuvres Complètes. 1878. Vol.III. pp.162-163.

After this interlude of description Darwin returns to his main theme, and summarises the emergence of life from the waves in a description of Venus rising from the sea, taken from a representation on an ancient gem which he supposes to be an hieroglyphic emblem of "the beauty of organic Nature rising from the sea."[1] Urania now pauses; then reiterates her explanation that the development of life from aquatic to terrestrial forms can still be seen in the life-history of the individual, even in that of the human individual:

> "Thus in the womb the nascent infant laves
> Its natant form in the circumfluent waves;
> With perforated heart unbreathing swims,
> Awakes and stretches all its recent limbs;
> With gills placental seeks the arterial flood,
> And drinks pure ether from its Mother's blood."[2]

And then, again, Darwin sums up his argument with a picture from classical mythology, a paraphrase of Ovid's account of the production of animals from the mud of the Nile,[3] a story, which, he explains, seems to be of Egyptian origin,

> ..."and is probably a poetic account of the opinions of the magi or priests of that country; showing that the simplest animations were spontaneously produced like chemical combinations, but were distinguished from the latter by their perpetual improvement by the power of reproduction, first by solitary, and then by sexual generation;"[4]

---

(1) T.N. I. ll.371-78 and l.372, n. See. The Heathen Mythology. p.
(2) T.N. I. ll.389-94.
(3) T.N. I. ll.401-20.
(4) T.N. I. l.417, n.

The fable lends itself admirably to illustration of Darwin's theory of the antiquity of scientific knowledge, and rounds off the canto with a clear and vividly drawn picture. Despite his belief in the antiquity of human knowledge, however, Darwin is convinced that the world is still in its youth, and has before it the potentialities and opportunities of youth. Earlier in the canto, he had declared,

"Young Nature lisps, she is the child of God,"[1]

and he meant the youth of nature to be taken literally.

The footnote attached to the line not only explains his meaning. It is also a comment upon Darwin's personal outlook and upon that of the scientific age in which he lived. He says:

> "The perpetual production and increase of the strata of limestone from the shells of aquatic animals; and of all those incumbent on them from the recrements of vegetables and of terrestrial animals, are now well understood from our improved knowledge of geology; and show, that the solid parts of the globe are gradually enlarging, and consequently that it is young; as the fluid parts are not yet all converted into solid ones. Add to this, that some parts of the earth and its inhabitants appear younger than others; thus the greater height of the mountains of America seems to show that continent to be less ancient than Europe, Asia, and Africa; as their summits have been less washed away, and the wild animals of America as the tigers and crocodiles, are said to be less perfect in respect to their size and strength; which would show them to be still in a state of infancy, or of progressive improvement. Lastly, the progress of mankind in

(1) T.N. I. l.224.

> arts and sciences, which continues slowly to extend, and to increase, seems to evince the youth of human society; whilst the unchanging state of the societies of some insects, as of the bee, wasp and ant, which is usually ascribed to instinct, seems to evince the longer existence, and greater maturity of those societies. The juvenility of the earth shows, that it has had a beginning or birth, and is a strong natural argument evincing the existence of a cause of its production, that is of the Deity."[1]

The argument in itself is not logically sound, since Darwin uses his own hypothesis concerning the origin of the earth to prove its juvenility, and then deduces the origin from the juvenility. To prove the recent origin of America, too, he adapts to his own purposes a theory put forward by Buffon,[2] but ignores the fact that Buffon had acknowledged the high antiquity of certain parts of the American continent. But the main facts that emerge are, first, that life has been evolving into its present forms over long ages; secondly, that different parts of the earth and the animals which inhabit them are at different stages of development; and thirdly, that the earth is young, if its age is measured not in years but in terms of the progress of life. The theory is one of complete optimism. Darwin sees only a continual growth and development, without the counterbalancing forces of destruction. All is advancing towards perfection. Human progress is evinced by the growth of the arts and sciences, and man, unlike other forms of life, has

---

(1) T.N. I. 1.224, n.
(2) Buffon. Oeuvres Complètes. 1878. Vol.I. p.71 ff and Vol.IV. p.159 ff.

not yet reached the final stage of his evolution. He still advances, still improves. The improvement must have seemed very real to Darwin as he looked round upon the scientific achievements of his own day, as he noted the enormous strides which had been made in nearly every department of natural knowledge. It must have been an inspiring prospect. The concept of evolution had taken possession of the mind of the period, but the phrase "natural selection", with all its implications, was as yet unknown.

THE REPRODUCTION OF LIFE

The first canto ends on a note of optimism. Life arrests the elements, stays for a time their chemic change, and arranges them, in a ceaseless progression, in increasingly complex forms. It perpetually advances and improves. The second canto shows the reverse side of the picture. This ceaseless progression, which means advancement for the species, means death for the individual. The most complex organism must eventually dissolve into its elements and make way for its successors. From this there is no escape.

> "How short the span of LIFE! some hours possess'd,
> Warm but to cool, and active but to rest!-"[1]

This is amplified in a note:

> "The thinking few in all ages have complained of the brevity of life, lamenting that mankind are not allowed time sufficient to cultivate science, or to improve their intellect. Hippocrates introduces his celebrated aphorisms with this idea; 'Life is short, science long, opportunities of knowledge rare, experiments fallacious, and reasoning difficult'.
> - A melancholy reflection to philosophers!"[2]

The prose statement is the more effective. Darwin's is a regret of and for the intellect, not the heart-felt fear of mutability which finds its natural expression in poetry. He feels, but the feeling springs from an

---

(1) T.N. II. ll.1-2.
(2) T.N. II. l.1, n. cf. <u>Zoonomia</u>. Vol.II. 1796. p.408.

intellectual conception; and in verse, as well as in prose, it is the conception which is expressed. He is concerned with a scientific statement in verse of the processes of old age and death, rather than with emotional or moral reflection. So he continues:

"The age-worn fibres goaded to contract,
By repetition palsied, cease to act,
When Time's cold hands the languid senses seize,
Chill the dull nerves, the lingering currents freeze;
Organic matter, unreclaim'd by life,
Reverts to elements by chemic strife."[1]

An Additional Note explains that the immediate cause of the physical decay which accompanies old age is a gradual decrease of the irritability of the muscular fibres, organs of sense, and glands of the brain. Darwin favours the use of warm baths to preserve irritability, and recommends the conservation of the power of irritation by "the due management of the quantity of every kind of stimulus."[2] The exertion of voluntary power, however, he believes to encourage the secretion of the spirit of animation and thus to counteract the advances of inirritability. He has observed "that many who have exerted much voluntary effort during their whole lives, have continued active to great age".[3] Those to whom old age and death come, according to Darwin's reckoning, as the greatest deprivation are those,

---

(1) T.N. II. 11.3-8.
(2) T.N. Add. Note VII. p.28.
(3) Ibid., p.30.

therefore, who have the means of delaying their approach. To him, mental activity is everything; it is the substance and purpose of life; and a certain pathos creeps through the scientific statement of the Note.

Death, however, has one consolation. Though the single organism must perish, the species continues; youth follows upon age, life is handed on, and the father sees himself continued in his children:

"But REPRODUCTION with ethereal fires
New Life rekindles, ere the first expires;
Calls up renascent Youth, ere tottering age
Quits the dull scene, and gives him to the stage;
Bids on his cheek the rose of beauty blow,
And binds the wreaths of pleasure round his brow;
With finer links the vital chain extends,
And the long line of Being never ends."[1]

The vital chain, now completely temporalized, represents here the successive movement of the generations. It is, moreover, a ladder of progress: and Darwin reaffirms the theory of organic evolution which he had derived from Buffon:

"Where milder skies protect the nascent brood,
And earth's warm bosom yields salubrious food;
Each new Descendant with superior powers
Of sense and motion speeds the transient hours;
Braves every season, tenants every clime,
And Nature rises on the wings of Time."[2]

The material of which the links of the chain or the rungs of the ladder are composed, however, does not vary:

---

(1) T.N. II. ll.13-20.
(2) T.N. II. ll.31-36.

"Organic forms with chemic changes strive
Live but to die, and die but to revive!
Immortal matter braves the transient storm,
Mounts from the wreck, unchanging but in form.-"[1]

The circulation of matter is re-stated as the story of Adonis, in verse similar to that of the earlier version in The Economy of Vegetation.[2] A note explains the significance of the myth, and re-interprets the story of Venus rising from the sea as a representation of organic Nature, elevated from the primeval ocean.[3] For, it will be remembered, "Organic Life began beneath the waves"[4] and emerged on to dry land in the course of time. This is a digression from Darwin's main theme. He returns to the subject of reproduction, the main theme of the canto, and explains the different ways in which this may take place.

The simplest means by which the species is continued is that of solitary reproduction, exemplified in the formation of vegetable buds and bulbs:

"From each young tree, for future buds design'd
Organic drops exsude beneath the rind;
While these with appetencies nice invite,
And those with apt propensities unite;
New embryon fibrils round the trunk combine
With quick embrace, and form the living line:
Whose plume and rootlet at their early birth
Seek the dry air, or pierce the humid earth."[5]

---

(1) T.N. II. ll.41-44.
(2) T.N. II. ll.45-60. cf. E.V.II. ll.585-610.
(3) T.N. II. l.47, n. See above, The Heathen Mythology, p.185
(4) T.N. I. l.234.
(5) T.N. II. ll.75-82.

Every vegetable bud, according to Darwin's physiology of plants, has its root, which grows down over the parent plant to the earth. This explains the final couplet. The lines are an exposition of Darwin's revised theory of generation, given in the third edition of the Zoonomia, in the Phytologia, and in an Additional Note to the poem.[1] In this Note he explains that reproduction is of two kinds, solitary and sexual. In both kinds the new individual is formed from a congress of two types of particles, secreted by two sets of glands; one set of particles possesses the appetency to unite, the other the propensity to be united. In solitary reproduction, both kinds of particles are secreted by the same individual, and unite to form an embryo, as in the production of a vegetable bud, or that of very simple types of animals such as the hydra or the taenia. Sexual reproduction is of two kinds, hermaphrodite sexual reproduction, in which the two types of particles are still produced by the same individual, but which unite with the appropriate particles produced by another hermaphrodite individual, and sexual reproduction proper, in which the embryo is formed by a conjunction of particles provided by two individuals of different sexes. The three modes of reproduction represent three successive stages in an evolutionary development of organic forms:

(1) T.N. Add. Note VIII.

> ".... it would appear that vegetables and animals were at first propagated by solitary generation, and afterwards by hermaphrodite sexual generation; because most vegetables possess at this day both male and female organs in the same flower, which Linneus has thence well called hermaphrodite flowers; and that this hermaphrodite mode of reproduction still exists in many insects, as in snails and worms; and, finally, because all the male quadrupeds, as well as men, possess at this day some remains of the female apparatus, as the breasts with nipples.......
>
> Afterwards the sexes seem to have been formed in vegetables as in flowers, in addition to the power of solitary reproduction by buds.........but the larger and more perfect animals are now propagated by sexual reproduction only, which seems to have been the chef-d'oeuvre, or capital work of nature;......"[1]

Darwin's description of the different modes of reproduction is in outline similar to that given by Buffon in his _Variétés dans la Génération des Animaux_.[2] In any case the facts and examples given by both Darwin and Buffon must have been fairly widely known. The idea of an evolution of modes of reproduction, however, seems to be based directly on Buffon, who had suggested it tentatively, and who had regarded male nipples as vestigial organs.[3] Darwin goes further still. He conjectures that the story of the creation of Eve from Adam's rib "might have been an hieroglyphic design of the Egyptian philosophers, showing their opinion that Mankind was originally of both sexes united, and was afterwards divided into males and females."[4] The idea might well have sprung from a reading of the _Archaeologicae Philosophicae_ of Thomas Burnet,[5] who had

(1) T.N. Add.Note.VIII. p.35.
(2) Buffon. _Oeuvres Complètes_. 1878. Vol.III. Chap.IX.
(3) Ibid. Vol.III. p.129; p.201; p.605.
(4) T.N. Add. Note X. p.42.
(5) Translated Foxton. 1729. Part I. Chap.I.

suggested that the Mosaic records were not historical but allegorical, and had interpreted the story of the creation of Eve as a recommendation to marriage. In the same context he had referred to the account given by Plato of the origin of the sexes from the first hermaphrodite human being. That Darwin's conjecture is otherwise a personal one seems likely from the fact that he had elsewhere put forward other interpretations of the fable. In The Economy of Vegetation Adam and Eve had appeared as hieroglyphic figures of Egyptian origin, representing mankind;[1] and in the Zoonomia the formation of Eve from a rib of Adam is made an allegory of "the reproduction of animals from a single living filament of their fathers."[2] Solitary reproduction, the primary means by which the race is perpetuated, is also the basis of social union:

> "Parturient Sires caress their infant train,
> And heaven-born STORGE weaves the social chain;
> Successive births her tender cares combine,
> And soft affections live along the line."[3]

An Additional Note explains that parental affection for progeny, apparent in the higher forms of animal life, may be supposed to have existed before animals were divided into sexes, and thus to have produced the beginning of sympathetic society. The affection is accounted for by

---

(1) E.V. Add. Note. XXII. p.55.
(2) Zoonomia. Vol.I. 1796. p.493.
(3) T.N. II. 11.91-94.

the pleasure resulting from increased stimulation of the glands. Thus, in the higher animals "an additional pleasure is produced by the new secretion of milk".[1] "This", Darwin adds, "appears to be one of the great secrets of Nature, one of those fine, almost invisible cords, which have bound one animal to another."[2] The theory sounds strangely modern. It may perhaps owe something to Helvetius's doctrine of self-love as the basis of all human passions and sympathies; its roots are probably in medical theory.

Solitary reproduction, however, as a means of perpetuating the species, has grave disadvantages. Not only does every generation exactly resemble its predecessors, thus failing to improve upon them, but it also transmits to its successors hereditary diseases which eventually destroy the race. Organic life as a whole has overcome these disadvantages by evolving a new method of reproduction, the sexual method. Eventually:

> "Increasing wants the pregnant parents vex
> With the fond wish to form a softer sex;
> Whose milky rills with pure ambrosial food
> Might charm and cherish their expected brood.
> The potent wish in the productive hour
> Calls to its aid Imagination's power,
> O'er embryon throngs with mystic charm presides,
> And sex from sex the nascent world divides,....."[2]

---

(1) T.N. Add. Note IX. p.41.
(2) Ibid.
(3) T.N. II. ll.113-20.

A note explains that "The manner in which the similarity of the progeny to the parent, and the sex of it, are produced by the power of imagination, is treated of in Zoonomia. Sect. 39. 6. 3."[1], and we must therefore turn to the Zoonomia. The whole theory depends upon Darwin's own system of psychology. He believed that the immediate cause of perception was the activity of the spirit of animation, which could act in four different modes, conveying to the brain ideas of irritation, sensation, volition and association.[2] He defines an idea as a contraction, motion or configuration, of the fibres which constitute the immediate organs of sense, such as the retina of the eye.[3] Thus:

> "....when any action presents itself to the view of a child, as of whetting a knife, or threading a needle, the parts of this action, in respect of time, motion, figure, is imitated by a part of the retina of his eye."[4]

That is to say, that the stimulated part of the retina exactly resembles, in figure, the external object which has excited it into motion. The motion is brought about by the spirit of animation. Darwin also thinks that the configuration assumed by one set of fibres can be imitated by another set, so that the child on whose retina is imprinted

---

(1) T.N. II. l.118, n.
(2) T.N. Add. Note II and Zoonomia, Vol.I. 1796, p.32.
(3) Zoonomia, Vol.I. 1796, p.11 and p.21 ff.
(4) Ibid. p.257.

the action of threading a needle can transfer the action to the locomotive muscles, and thus perform it, imitatively, with his hands.[1] And just as the locomotive muscles can imitate visual ideas, so can the fibres of the organs of generation. It will be remembered that Darwin's earlier opinion was that the embryon is produced by the male, who therefore determines its sex and form by the following means:

> "....it is probable, that the acting fibres of the ultimate terminations of the secreting apertures of the vessels of the testes, are as fine as those of the retina; and that they are likely to be thrown into that peculiar action, which marks the sex of the secreted embryon, by sympathy with the pleasurable motions of the nerves of vision or touch; that is, with certain ideas of imagination."[2]

The imagination of the male therefore endows the filament which constitutes the rudimentary embryo "with propensities, or appetences, (sic) which shall produce by accretion of parts the similarity of form, feature, or sex, corresponding to the imagination of the father."[3]

The theory will hardly bear close analysis. And by the time Darwin came to write The Temple of Nature he had rejected this earlier theory of generation, so that

---

(1) Ibid., p.257. Darwin's theory seems to have something in common with that put forward by Malebranche. See, Treatise concerning the Search after Truth. Trans. T.Taylor. 1694. p.57.
(2) Zoonomia. Vol.I, 1796, p.524.
(3) Ibid. p.524.

presumably his view of the effect of the male imagination on the embryo would require modification, though no indication is given of this. Furthermore, in the Zoonomia he is considering an embryo produced by the conjunction of two already existing sexes, whereas in the poem the whole question is the production of embryos of different sexes by a single asexual parent. Since the female sex did not exist, the father could not possess an imaginative idea of it, especially as the father in question seems to have been some animal similar to an oyster or a greenfly.

As illustration of the transition from asexual to sexual reproduction Darwin mentions the tulip and the aphis, both of which exhibit during the course of their life-history the change from the one mode to the other achieved by the rece in its evolution:

> "So tulip-bulbs emerging from the seed,
> Year after year unknown to sex proceed;
> Erewhile the stamens and the styles display
> Their petal-curtains, and adorn the day;
> The beaux and beauties in each blossom glow
> With wedded joy, or amatorial woe.
> Unmarried Aphides prolific prove
> For nine successions uninform'd of love;
> New sexes next with softer passions spring,
> Breathe the fond vow, and woo with quivering wing."[1]

The theory that mankind itself was originally hermaphrodite and later became divided into two sexes, mentioned again in a footnote,[2] is expressed in verse thus:

---

(1) T.N. II. ll.125-34.
(2) T.N. II. l.122, n.

"So erst in Paradise creation's LORD,
As the first leaves of holy writ record,
From Adam's rib, who press'd the flowery grove,
And dreamt delighted of untasted love,
To cheer and charm his solitary mind,
Form'd a new sex, the MOTHER OF MANKIND."[1]

There seems to be no clear distinction between the differentiation into two sexes achieved finally by some species in the course of development from lower forms, and that which occurs at regular intervals within certain species, such as the aphis. Darwin does not state explicitly whether he believes the human race to have been originally hermaphrodite, or whether he merely thought that it had evolved from more primitive hermaphrodite forms. His evidence, the existence of male teats, is taken from Buffon who seems to uphold the latter view, but in any case opinion was bound, in the contemporary state of knowledge, to be tentative and indefinite.

The description of Adam and Eve in the Garden of Eden, which follows the lines quoted above, is interesting because it shows Darwin adapting Milton's description to his own poetic style, and it should be compared with the corresponding passages of Paradise Lost.[2] It is noticeable that Darwin, for whom the Garden of Eden is a myth, or at

---

(1) T.N. II. ll.135-40.
(2) T.N. II. ll.141-58. cf. Paradise Lost. IV. ll.288-311 and ll.440-504. (The Poetical Works of John Milton. ed. H.C. Beeching. Oxford. 1941. pp.253-58.)

best a scientific allegory, and who feels none of the religious and moral impulses which directed Milton, portrays Adam and Eve simply as the personifications of physical desire and physical beauty. The story offers every opportunity for appeal to the visual imagination, and in giving rein to his skill in decorative writing, and unrestrained by religious feeling, Darwin falls into an error of taste.

Most of the remainder of the canto consists of an amplification of the theme stated in the Additional Note on Reproduction. The evil of hereditary disease, the result of solitary reproduction or of inbreeding, is graphically described in verse, and allows of a brief poetic excursion into the graveyard, a "pathetic" passage which accords oddly with the scientific tone of the major part of the canto.[1] In an Additional Note on Hereditary Diseases Darwin as a medical man, applies himself to the practical side of the problem:

> "Finally the art to improve the sexual progeny of either vegetables or animals must consist in choosing the most perfect of both sexes, that is the most beautiful in respect to the body, and the most ingenious in respect to the mind;.....
> "As many families become gradually extinct by hereditary diseases, as by scrofula, consumption, epilepsy, mania, it is often hazardous to marry an heiress, as she is not unfrequently the last of a diseased family."[2]

---

(1) T.N. II. ll.185-204.
(2) T.N. Add.Note XI. p.45.

He turns then to brighter prospects, and describes the marriage of Cupid and Psyche, symbols of sexual love, whose union constitutes the second chain of society.[1] The dominion of love over the animal and vegetable world, from the snail to man, from the flower to the butterfly, is illustrated in a series of verse pictures. Then follows the other result of love, which, besides being the chain of society, is also the source of jealousy and conflict. Fighting cocks and quails, stags and boars contending among themselves for possession of the female, lead up to a struggle between medieval knights for the favours of beauty, which is certainly a new poetic application of the theme of chivalry. Then the tone changes again, and we are returned to connubial love, exemplified by the linnet and the nightingale, building their nests and caring for their young. On the fabrication of nests, Darwin refers the reader to the section on instinct in the _Zoonomia_,[2] which must be considered briefly here, since it forms an important part of his evolutionary theory.

He is anxious to disprove the common belief that instinct is "a _divine something_, a kind of inspiration",[3] and to show that animals can acquire knowledge by experience

---

(1) T.N. II. 11.221-50.
(2) T.N. II. 1.348, n.
(3) _Zoonomia_, Vol.I. 1796. p.137.

and reason, and can transmit it to their young, who learn by imitation. He believes that all animal actions that are attended with consciousness are acquired "by the repeated efforts of our muscles under the conduct of our sensations or desires."[1] He is at pains to cite examples of behaviour in quadrupeds, birds, fish and insects which he believes to be the result of observation and the exercise of reason. Thus birds construct their nests in a manner which is the result of knowledge acquired by their ancestors, and learned by succeeding generations by imitation.[2] Darwin was obstinate in upholding this opinion, in the face of contradictory evidence, as Miss Seward has related.[3] Similarly, he thinks that the care exercised by the mother bird in incubating her eggs may have been learned by experience, since "the ostrich is said to sit upon its eggs only in the night in warm situations, and both night and day in colder ones."[4]

The canto resolves itself into the triumphal progress of Cupid and Psyche, symbolising the harmonising and unifying power of sexual love. As they advance, the lion, the tiger, "the scaly realms", "the feather'd nations", fawns, nereids, tritons and naiads advance to pay their

---

(1) Ibid., p.138.
(2) Ibid., p.171.
(3) Anna Seward. Memoirs of the Life of Dr. Darwin. 1804. p.86 ff.
(4) T.N. Add. Note IX. p.40.

homage; and Flora greets them as they pass. Hymen marches on with his torch, and

"With lovely life all Nature's frame inspires,
And, as they sink, rekindles all her fires."[1]

At this, Urania pauses and demands refreshment:

"Now at her nod the Nymphs attendant bring
Translucent water from the bubbling spring;
In crystal cups the waves salubrious shine,
Unstain'd untainted with immodest wine.
Next, where emerging from its ancient roots
Its widening boughs the Tree of Knowledge shoots;
Pluck'd with nice choice before the Muse they placed
The now no longer interdicted taste.
Awhile they sit, from higher cares released,
And pleased partake the intellectual feast.
Of good and ill they spoke, effect and cause,
Celestial agencies, and Nature's laws."[2]

The symbolic position of the Temple of Nature upon the ancient site of Paradise is thus made clear. The forbidden fruit of the tree is the knowledge of Nature's laws, no longer, however, forbidden. Darwin has traced humanity to its origins, and has substituted for the idea of a special creation by a personal God and the injunctions of an anthropomorphic deity the ceaseless progression of cause and effect, emanating from the Great First Cause.

The nymphs, gathered round the Tree of Knowledge, are compared, in a final simile, to the angelic guests entertained by Abraham in Syria, and the canto thus ends on a discreetly biblical note.

(1) T.N. II. 11.423-24.
(2) T.N. II. 11.435-46.

THE PROGRESS OF THE MIND

The first two cantos of The Temple of Nature describe the evolutionary development of organic forms from an original living filament to man, the most complex of existing organisms. The subtitle of the poem, however, is The Origin of Society. And in the third canto Darwin shows how, out of the physiological processes which distinguish living things from inanimate matter, have developed mental processes which distinguish man from lower forms of life, and which have produced a civilised society composed of intellectual and moral beings. These mental processes Darwin regards as strictly natural phenomena, subject to natural laws, and open to investigation and explanation in the same way as other natural phenomena. This is made quite clear by the opening lines of the poem. Urania and the Muse explore the Temple of Nature,

> "Pervade her labyrinths with unerring tread,
> And leave for future guests a guiding thread."[1]

They survey the earth, from air to ocean, from the equator to the poles; they note the gaseous composition of the atmosphere, and of water; they consider the laws of optics, electricity, magnetism, gravitation and heat; and last they note

---

(1) T.N. III. ll.7-8.

"... how born in elemental strife
Beam'd the first spark, and lighten'd into Life."[1]

The Muse then turns to Urania, and exclaims:

"Immortal Guide! O, now with accents kind
Give to my ear the progress of the Mind.
How loves, and tastes, and sympathies commence
From evanescent notices of sense?
How from the yielding touch and rolling eyes
The piles immense of human science rise? -
With mind gigantic steps the puny Elf,
And weighs and measures all things but himself."[2]

Urania's answer is an exposition of Darwin's theory of psychology, together with the theory of aesthetics which depends on it, and an explanation of the foundation of the arts and sciences, the origin of language, and the basis of the moral sense. The psychology and aesthetics have been dealt with at some length by Mr J.V.Logan, in The Poetry and Aesthetics of Erasmus Darwin, and there is little to be added here to what he has already said. The aim of the present chapter is to indicate the relevance of Darwin's psychology to his consideration of man and society, and to the place of this consideration in the poem as a whole. For his theories of arts, sciences, languages and morals are closely dependent on his theory of the nature of the mind and its relationship to the body.

(1) T.N. III. ll.33-34.
(2) T.N. III. ll.41-48.

The fundamental assumption upon which Darwin's theory of the mind rests, and which is implicit in the lines quoted above, is Locke's teaching that all knowledge is derived through the senses. From this point he sets out to show how, by an operation of the spirit of animation upon sensorial and muscular fibres, caused by external stimuli, the four powers of irritation, sensation, volition and association produce ideas and actions. All the mental impressions and powers of man, and of the lower animals, depend upon the contraction of the living fibre in response to a stimulus conveyed by the spirit of animation. Mind is thus defined in terms of physiology. The whole theory is explained in detail in the <u>Zoonomia</u>. Its main features are given in an Additional Note attached to the first canto of <u>The Temple of Nature</u>.[1] and the third canto contains a verse summary of it, with amplification where necessary in the footnotes. The whole system owes much to Hartley's <u>Observations on Man</u>. Darwin substitutes contractions for vibrations; but he gets no nearer than Hartley to the real problem, of how perception takes place. If the fact of perception is assumed, however, his system and the applications to which he puts it show a certain unity, and illustrate his tendency to synthesise, his desire to trace the inter-relationships of natural laws.

---

(1) T.N. Add. Note II.

The basis of the psychological theory is the power of the contractile fibres which compose the organs of sense to assume configurations. That part of the organ of touch, for example, which is in contact with an external object, is compressed by it, and the "idea" conveyed to the brain, or central part of the sensorium, is a configuration of fibres corresponding exactly to the form of the object perceived. All ideas are "animal motions of the organs of sense."[1] So, "animal activity of the retina constitutes vision";[2] and visual ideas are configurations of the fibres which compose the retina, corresponding to the form of the object. Similarly the immediate organ of hearing is stimulated into motion by vibrations of the air, or sounds. Mr. Logan has said that in the Zoonomia Darwin does not distinguish between the primary and secondary qualities of objects, defined by Locke, that he did not believe that colours, sound, light and smells "were qualities existing in the mind alone; they are irritative ideas which resemble qualities in the objects which excite them".[3] It seems to me, however, that Darwin's acceptance of the distinction between primary and secondary qualities is clearly shown by the following remarks:

---

(1) Zoonomia. Vol.I. 2nd ed.1796. p.23.
(2) Ibid. p.18.
(3) J.V. Logan. The Poetry and Aesthetics of Erasmus Darwin. [Princeton Studies in English. No.15]. Princeton University Press. 1936 p.82.

> "When the idea of solidity is excited...... a part of the extensive organ of touch is compressed by some external body, and this part of the sensorium so compressed exactly resembles in figure the figure of the body that compressed it. Hence, when we acquire the idea of solidity, we acquire at the same time the idea of FIGURE; and this idea of figure, or motion of a part of the organ of touch, exactly resembles in its figure the figure of the body that occasions it; and thus exactly acquaints us with this property of the external world."[1]

He then proceeds to show that ideas of motion, time, place, space and number are merely modifications of the idea of figure, and concludes:

> "Hence arises the certainty of the mathematical sciences, as they explain these properties of bodies, which are exactly resembled by our ideas of them, whilst we are obliged to collect almost all our other knowledge from experiment: that is, by observing the effects exerted by one body upon another."[2]

The fact that there are other ideas which do not correspond exactly to the properties of bodies is implied in this statement. Furthermore, the passage quoted above forms part of a section of the Zoonomia which, Darwin had promised earlier in the work, was to explain in detail his theory of the perception of the qualities of objects. He had remarked that an objector to his system might ask

> "Can the motion of an organ of sense resemble an odour or a colour?"[3]

He replied:

> "To which I can only answer, that it has not been demonstrated that any of our ideas resemble the objects

---

(1) Zoonomia, Vol.I. 1796. p.111.
(2) Ibid., p.113.
(3) Ibid., p.27.

> that excite them; it has generally been believed that they do not; but this shall be discussed at large in Sect.XIV."[1]

His explanation of how the sense of touch exactly acquaints us with that property of bodies which is called figure is surely an answer to the question. And since he defines motion as a perpetual variation of figure,[2] the statement, which occurs a little later in this same section, that

> "....the immediate organ of hearing is not affected by the particles of the air themselves, but is stimulated into animal motion by the vibrations of them."[3]

implies that ideas of sound are, basically, ideas of figure. It would nevertheless be difficult to explain the sensation of sound in terms of figure, or motion. And Darwin nowhere attempts to account for sensations as such. In his Presidential Address to the ~~Literary and~~ Philosophical Society of Derby, however, delivered in 1784, he had said:

> "The great Malbranch, after having studied and explain'd with wonderful acuteness the means by which we acquire our ideas, concludes with a very melancholy reflection, 'That our senses are given us for the preservation of our bodies, and not for the researches of philosophy'. For in what, sais he, do our sensations resemble the properties of bodies, which excite those sensations? Does our sensation of sound resemble the vibrations of the atmosphere? does our sensation of taste or of smell resemble the particles of bodies, which are soluble in water or in air? Does the sensation of colours resemble the refracted rays of light?"[4]

---

(1) Ibid., p.27-8.
(2) Ibid., p.112.
(3) Ibid., p.119.
(4) Copy of Dr.Darwins address to the Philosophical Society of Derby at their first meeting, preserved at Down House.

The rest of the address consists of an explanation of how accurate ideas may be acquired, first, from the sense of touch, which exactly acquaints us with the figure of objects, and secondly from experimental philosophy. It thus seems clear that Darwin distinguishes between figure and those qualities which are modifications of figure, and qualities which are not resembled by the sensations they occasion. His statement of the distinction between the two groups of qualities does not correspond exactly with that of Locke; but the principle behind both statements is the same.

The distinction is important, since the superiority which Darwin attributes to the sense of touch depends upon it. Man, who possesses this superior sense developed to a degree unknown to any other animal, has from it acquired the clear ideas which have given him an ascendancy over allother forms of life. In The Progress of the Mind Darwin explains that many of the lower animals are endowed with keener senses of sight, hearing and smell, and are therefore better equipped, physically, for attack and self-defence. Man, without these advantages, is nevertheless pre-eminent:

> "The human species in some of their sensations are much inferior to animals, yet the accuracy of the sense of touch, which they possess in so eminent a degree, gives them a great superiority of understanding, as is well observed by the ingenious Mr.Buffon."[1]

---

(1) T.N. III. 1.122, n. cf. Buffon. Oeuvres Complètes. 1878. Vol.III. p.262.

Thus:

"Nerved with fine touch above the bestial throngs,
The hand, first gift of Heaven! to man belongs;
Untipt with claws the circling fingers close,
With rival points the bending thumbs oppose,
Trace the nice lines of Form with sense refined,
And clear ideas charm the thinking mind.
Whence the fine organs of the touch impart
Ideal figure, source of every art;
Time, motion, number, sunshine or the storm
But mark varieties in Nature's <u>form</u>."[1]

A footnote explains that, since the sense of touch provides ideas of figure, it "exactly acquaints us with this property of the external world."[2] The whole note, together with the verse, is derived from that section of the <u>Zoonomia</u> quoted above. Nevertheless, although touch, as the source of accurate ideas, is the sense on which Darwin lays most stress, he accords to sight that importance which Berkeley had bestowed upon it. He adopts Berkeley's theory that "Visible figures are the marks of tangible figures;.... which by nature they are ordained to signify",[3] and explains:

"Symbol of solid forms is colour'd light,
And the mute language of the touch is sight."[4]

Berkeley, however, had discovered no necessary connection between the ideas admitted by the different senses. Darwin, by making the tangible and visible ideas of an object both to consist of certain motions of the sense-organ

---

(1) T.N. III. ll.121-30.
(2) T.N. III. l.125, n.
(3) George Berkeley. <u>An Essay towards a New Theory of Vision</u>. 1709. [See <u>The Works of George Berkeley</u>. ed. A.C.Fraser. 1871. Vol.I. p.100].
(4) T.N. III. ll.143-4.

which reproduce the figure of the object in the sensorium, also makes the visible idea of figure correspond exactly with the tangible. The visible idea, nevertheless, is but a reproduction in miniature of the figure of the object perceived, so that the tangible idea is the only accurate one; and man, whose superior sense of touch has given him accurate ideas, has developed intellectual faculties beyond those of any other animal.

Having demonstrated the importance of touch, and its relation to sight, Darwin proceeds to an exposition of his theory of Taste, which is defined as "the pleasures consequent to the exertion of our sense of vision."[1] This has been fully treated by Mr.Logan, and we need only note here that, in Darwin's view, aesthetic qualities depend upon man's clear visual ideas, derived from clear tangible ideas, and modified in some cases by association. Aesthetics, however, is concerned with the appreciation of the beautiful, the sublime, and other qualities of the objects of art and nature. Darwin next attempts to account for the creation by man of objects which possess these qualities. And this, too, depends on the possession of accurate ideas. The foundation of arts, and also of languages and morals, is man's power to imitate. The reader is referred to that section of the Zoonomia where it is explained that perception itself is

---

(1) T.N. Add. Note XIII. p.80.

imitation, that "our perceptions themselves are copies, that is, imitations of some properties of external matter."[1] Imitation of actions, furthermore, consists in the repetition by one set of fibres of what has just been performed by another.[2] So that,

> "... the immediate cause of our propensity to imitation above that of other animals arises from the greater facility, with which by the sense of touch we acquire the ideas of the outlines of objects, and afterwards in consequence by the sense of sight."[3]

Thus, when Michael Angelo created the dome of St. Peter's, the different parts of the design

> "Were first by Fancy in ethereal dyes
> Plann'd on the rolling tablet of his eyes;
> And his true hand with imitation fine
> Traced from his Retina the grand design."[4]
> . . . .
> "Hence to clear images of form belong
> The sculptor's statue, and the poet's song,
> The painter's landscape and the builder's plan,
> And IMITATION marks the mind of Man."[5]

We come next to the part played by imitation in the formation of language:

> "WHEN strong desires or soft sensations move
> The astonish'd Intellect to rage or love;
> Associate tribes of fibrous motions rise,
> Flush the red cheek, or light the laughing eyes.
> Whence ever-active Imitation finds
> The ideal trains, that pass in kindred minds;
> Her mimic arts associate thoughts excite
> And the first LANGUAGE enters at the sight."[6]

---

(1) T.N. III. 1.270, n. See <u>Zoonomia</u>. Vol.I, 1796.~~XXXX~~. p.258.
(2) <u>Zoonomia.</u> Vol.I. 1796, p.257.
(3) T.N. III. 1.270, n.
(4) T.N. III. 11.315-18.
(5) T.N. III. 1.331-4.
(6) T.N. III. 11.335-42.

A note[1] explains that we become acquainted with the passions of others, first, by having observed the effects of the same passions upon our own bodies, and so recognising them in others, and secondly, from putting ourselves, by imitation, into the attitudes occasioned by passions, and thus acquiring them in reality. The part played by imitation in this process Darwin derives from Burke, who had said:

> "I have often observed, that on mimicking the looks and gestures of angry, or placid, or frighted, or daring men, I have involuntarily found my mind turned to that passion, whose appearance I endeavoured to imitate; nay, I am convinced it is hard to avoid it, though one strove to separate the passion from its correspondent gestures."[2]

Burke, however, had been content to attribute the faculty of imitation to our natural constitution and the ways of Providence. Darwin explains it in physiological terms, and by adding to it the power of association, contrives to use it to account for the origin of language. For the signs of passion form a natural language, on which all artificial language is based. Thomas Reid had pointed out that an artificial language presupposes an agreement to affix certain meanings to certain signs, and this agreement

---

(1) T.N. III. 1.342, n.
(2) Edmund Burke. A Philosophical Inquiry into the Origin of our Ideas of the Sublime and the Beautiful. 1756. [The Works of the Right Honourable Edmund Burke. Bohn. 1889. Part IV. Sect. IV continued. p.146]

in its turn presupposes some form of communication or language, which must be a natural one. Its elements, Reid explained, are modulations of the voice, gestures, and features.[1] Darwin adopted this theory, and referred his readers to Reid's Inquiry into the Human Mind.[2] In the Zoonomia[3] he had gone further, and attempted to account for the origin of natural language. It was derived, he thought, from the effects upon the body of the new-born child of the world into which it arrives. Thus, the cold and dryness of the atmosphere stimulate the lachrymal sac and cause tears to flow. Tears are therefore associated in the infant mind with disagreeable sensations, and become for ever afterwards the sign of them.

From natural, Darwin passes to artificial language. A lengthy Additional Note, entitled The Theory and Structure of Language is concerned with grammar and its origin. The essence of the theory is that "Language consists of words, which are the names or symbols of ideas",[4] and that all the parts of speech, and all grammatical terminations, are derived from original substantives, or names of things, which were the words

---

(1) Thomas Reid. An Inquiry into the Human Mind, on the Principles of Common Sense. 1764 [4th ed. 1785. Chap.IV. Sect. II. p.91.ff.]
(2) T.N. III. 1.342, n.
(3) Zoonomia, Vol.I. 1796. p.147.ff.
(4) T.N. Add. Note XIV. p.93.

first invented. The inspiration of this was Horne Tooke's Diversions of Purley. Darwin's aim is to show "the progressive production of language in the early times of society, and its gradual improvements in the more civilised ones";[1] and man's acquisition of language is thus given its place in evolutionary progress. The idea of an evolution of language was not new. Lord Monboddo's work, Of the Origin and Progress of Language was known to Darwin, and he may have been acquainted with other theories of the subject, such as Adam Smith's Considerations concerning the First Formation of Language.

A second Additional Note contains a plan for the reformation of the alphabet, based on an analysis of articulate sounds, a subject on which, Darwin says, he has treated with greater confidence, since many years before he had given it considerable attention "for the purposes of improving shorthand."[2] In fact, in 1751 he had written a complimentary poem to Thomas Gurney, author of Brachygraphy, or Swift Writing Made Easy to the Meanest Capacity, which was prefaced to the second edition of that work, issued in 1752. The Additional Note thus incorporates the reflections of fifty years. It concludes

---

(1) Ibid., p.104.
(2) T.N. Add. Note XV. p.119.

"with an agreeable hope, that now war is ceased, the active and ingenious of all nations will attend again to those sciences, which better the condition of human nature; and that the alphabet will undergo a perfect reformation, which may indeed make it more difficult to trace the etymologies of words, but will much facilitate the acquisition of modern languages; which as science improves and becomes more generally diffused, will gradually become more distinct and accurate than the ancient ones; as metaphors will cease to be necessary in conversation, and only be used as the ornaments of poetry."[1]

Again, the idea was not new. John Wilkin's Essay towards a real Character and a Philosophical Language had been published in 1668. This Darwin knew. And he must also have been familiar with Locke's discussion of language in the Essay concerning Human Understanding.

From the ease with which man acquires clear ideas and expresses them in language, Darwin explains, springs facility of recollection, on which the power of reasoning depends. Reasoning is "that operation of the sensorium by which we excite two or many tribes of ideas, and then re-excite the ideas in which they differ or correspond."[2] And so,

"... REASON'S empire o'er the world presides,
And man from brute, and man from man divides;
Compares and measures by imagined lines
Ellipses, circles, tangents, angles, sines;
Repeats with nice libration, and decrees
In what each differs, and in what agrees;
With quick Volitions unfatigued selects
Means for some end, and causes of effects;
All human science worth the name imparts,
And builds on Nature's base the works of Arts."[3]

(1) Ibid., p.120.
(2) T.N. III. 1.401, n.
(3) T.N. III. 11.401-10.

Man, however, is not the only animal possessed of arts. The wasp constructs its nest, the bee its honeycomb, the silkworm its chrysalis. Following Buffon, Darwin explains:

> "Those animals which possess a better sense of touch are, in general, more ingenious than others.... Hence the excellence of the sense of touch in many insects seems to have given them wonderful ingenuity so as to equal or even excel mankind in some of their arts and discoveries; many of which may have been acquired in situations previous to their present ones, as the great globe itself, and all that it inhabit, appear to be in a perpetual state of mutation and improvement."[1]

In verse, he inquires:

"-Say, did these fine volitions first commence
From clear ideas of the tangent sense;
From sires to sons by imitation caught,
Or in dumb language by tradition taught?
Or did they rise in some primeval site
Of larva-gnat, or microscopic mite;
And with instructive foresight still await
On each vicissitude of insect-state? -
Wise to the present, nor to future blind,
They link the reasoning reptile to mankind!"[2]

This is a recapitulation of part of that chapter of the Zoonomia which is entitled Of Instinct, and in which Darwin maintains that many animal actions usually attributed to an inexplicable instinct are actually the result of exertions of the voluntary power, caused by

---

(1) T.N. III. 1.411, n. cf. Buffon. Oeuvres Complètes. 1878. Vol.III. pp.262-3.
(2) T.N. III. 11.423-32.

sensations. Since animals possessed of superior sense of touch are also, in consequence, possessed of clearer ideas and stronger sensations, they are further endowed with greater powers of volition, upon which arts and discoveries depend. Thus, Darwin declares:

> "If we were better acquainted with the histories of those insects that are formed into societies, as the bees, wasps, and ants, I make no doubt but we should find, that their arts and improvements are not so similar and uniform as they now appear to us, but that they arose in the same manner from experience and tradition, as the arts of our own species; though their reasoning is from fewer ideas, is busied about fewer objects, and is exerted with less energy."[1]

The story of organic evolution is thus almost complete. Darwin has shown how mind has developed from physical organs and processes, and how its most perfect manifestation, in the human species, is foreshadowed and evolved on a slighter scale in certain of the lower animals. And although the poetic exposition of the theory was undoubtedly never widely known, and soon forgotten, the fuller version given in the Zoonomia lived on until later into the nineteenth century. Samuel Butler, setting out to attack Charles Darwin's theory of natural selection, drew widely upon the work of his grandfather. He approved Darwin's explanation of instinct as a form of reason, but would have wished that Darwin had gone further, and attributed

---

(1) Zoonomia, Vol.I. 1796, p.183.

"instinctive actions" not only to reason and imitation, but also to an unconscious memory, whereby experience would be transmitted from parents to offspring.

> "If by 'previous experience'", Butler says, "we could be sure that Dr.Darwin persistently meant 'previous experience in the persons of their ancestors', he would be in an impregnable position. As it is, we feel that though he had caught sight of the truth, and had even held it in his hands, yet somehow or other it just managed to slip through his fingers."[1]

And in our own day, Darwin is remembered by upholders of creative evolution as a forerunner of greater theorists. So he finds mention, probably by way of Butler, in Mr. George Bernard Shaw's Preface to Back to Methuselah.[2]

In the poem, having described the rise of man's intellectual faculties, Darwin comments thus upon the superiority which they have given to the human race:

> "Unenvied eminence, in Nature's plan
> Rise the reflective faculties of Man!
> Labour to Rest the thinking few prefer!
> Know but to mourn! and reason but to err!-"[3]

Again the personal note, so infrequent in Darwin's poetry, creeps in for a moment. We catch a brief realisation of the stress exerted on this active and enquiring spirit by the necessity of accepting the limitations of the human mind and the penalties of knowledge. Man's powers of knowing through the senses teach him, finally,

---

(1) Samuel Butler. Evolution Old and New. 1879. [2nd impression of 3rd edition, 1921, p.204.]
(2) G.B.Shaw. Back to Methuselah. 1921. Preface [World's Classics. 1945. pp.ix,xix-xx.].
(3) T.N. III. 11.445-8.

that he cannot know. Then this pessimistic view is rejected. Darwin explains that, although some philosophers have believed the acquisition of knowledge to diminish the happiness of its possessor, yet,

> "... as the foresight and the power of mankind are much increased by their voluntary exertions in the acquirement of knowledge, they may undoubtedly avoid many sources of evil, and procure many sources of good; and yet possess the pleasures of sense, or of imagination, as extensively as the brute or the savage."[1]

The development from imitation of the visual arts and of language, the instrument of reason, have now been explained. There remains the third product of this faculty, the power of sympathy, foundation of all the moral virtues, and final achievement of the evolutionary process:

> "From our aptitude to imitation arises what is generally understood by the word sympathy, so well explained by Dr. Smith of Glasgow. Thus the appearance of a cheerful countenance gives us pleasure, and of a melancholy one makes us sorrowful. Yawning, and sometimes vomiting, are thus propagated by sympathy; and some people of delicate fibres, at the presence of a spectacle of misery, have felt pain in the same parts of their bodies, that were diseased or mangled in the object they saw.
>
> The effect of this powerful agent in the moral world, is the foundation of all our intellectual sympathies with the pains and pleasures of others, and is in consequence the source of all our virtues. For in what consists our sympathy with the miseries or with the joys of our fellow creatures, but in an involuntary excitation of ideas in some measure similar or imitative of those which we believe to exist in the minds of the persons whom we commiserate or congratulate!"[2]

---

(1) T.N. III. 1.456, n.
(2) T.N. III. 1.466, n.

Most of this is derived from Adam Smith's Theory of Moral Sentiments.[1] Smith makes sympathy, which he defines as "our fellow-feeling with any passion whatever",[2] the foundation of all the moral sentiments, and explains that emotions, and sometimes physical sensations, are communicated by sympathy. Darwin adds to this his own psychological theory of imitation, and thus explains the facts in scientific terms; though his theory is not based upon scientific observation.

Darwin is thus a materialist, and like many other materialists he is governed by a high moral idealism, which emerges in the closing passage of the canto. The Seraph Sympathy descends from heaven:

> "From heaven, He cried, descends the moral plan,
> And gives Society to savage man.
>
> High on yon scroll, inscribed o'er Nature's shrine,
> Live in bright characters the words divine.
> 'IN LIFE'S DISASTROUS SCENES TO OTHERS DO
> WHAT YOU WOULD WISH BY OTHERS DONE TO YOU.'
> - Winds! wide o'er earth the sacred law convey,
> Ye Nations, hear it! and ye Kings, obey!"[3]

---

(1) Adam Smith. The Theory of Moral Sentiments. 1759. [See The Works of Adam Smith, ed. Dugald Stewart. 1812. Vol.I. pp.2-5.]
(2) Smith, op.cit., p.5.
(3) T.N. III. ll.483-90. cf. Smith, op.cit., p.32.

OF GOOD AND EVIL

The first three cantos of The Temple of Nature describe the rise of civilised society, composed of intellectual beings occupied with the arts and sciences, communicating with each other by means of language, and bound together by the power of sympathy, the basis of the moral virtues. In the fourth and last canto of the poem Darwin considers man against his background. He looks upon nature as a whole, and attempts to find some justification of what he sees, some answer to the problem of the existence of evil. The Muse, in response to Urania's account of the origin and effects of sympathy, cries:

> "How few, alas! in Nature's wide domains
> The sacred charm of SYMPATHY restrains!
> Uncheck'd desires from appetite commence,
> And pure reflection yields to selfish sense!"[1]

Then it is Darwin, the student of the classics, who speaks:

> "- Blest is the Sage, who learn'd in Nature's laws
> With nice distinction marks effect and cause;
> Who views the insatiate Grave with eye sedate,
> Nor fears thy voice, inexorable Fate!"[2]

This is the attitude which, in the last canto of his final poem, Darwin urges upon his readers. Its attainment, however, is not without difficulty. Sympathy, it is

---

(1) T.N. IV. ll.3-6.
(2) T.N. IV. ll.7-10.

evident, plays little part in nature as a whole. More cruel laws prevail. He looks upon man, and sees war:

> "Death his vast sithe with sweep enormous wields,
> And shuddering Pity quits the sanguine fields."[1]

He looks upon the animal world, and sees the wolf devouring the lamb, the eagle seizing upon the dove. In their turn the lamb and the dove destroy plants and seeds. So, too, in the vegetable world:

> "Yes! smiling Flora drives her armed car
> Through the thick ranks of vegetable war;
> Herb, shrub, and tree, with strong emotions rise
> For light and air, and battle in the skies."[2]

Beneath the ocean, the larger animals prey upon the smaller. Everywhere there is cruelty and death:

> "- Air, earth, and ocean, to astonish'd day
> One scene of blood, one mighty tomb display!
> From Hunger's arm the shafts of Death are hurl'd,
> And one great Slaughter-house the warring world!"[3]

Nor is death the only evil. It must, indeed, come, even to man. But life itself is loaded with pains. Hunger, cold, labour, the diseases resulting from man's intemperance, tyranny, slavery, superstition, the sting of conscience, the loss of reason, or, last, melancholy, which killed Darwin's own son, have all to be borne while life endures. Nor are real pains the only source of misery. "Ideal ills", the evils conjured up by the imagination and the

---

(1) T.N. IV. 11.15-16.
(2) T.N. IV. 11.41-44.
(3) T.N. IV. 11.63-66.

power of association, lead to avarice, ambition, jealousy. Finally, man is subject to the larger forces of nature, flood, volcano, earthquake, pestilence and famine, who "swallows millions with unsated maw."[1]

Confronted with this picture of human life, the Muse exclaims;

"Ah where can Sympathy reflecting find
One bright idea to console the mind?
One ray of light in this terrene abode
To prove to Man the Goodness of his GOD?"[2]

Urania replies that the Muse

"Presents the evil, but forgets the good."[3]

And she, in her turn, reveals the brighter side of the picture. She explains how

". . . . . the powers of Life
Arrest the elements, and stay their strife;
From wandering atoms, ethers, airs, and gas,
By combination form the organic mass;
And, - as they seize, digest, secrete, - dispense
The bliss of Being to the vital Ens."[4]

Darwin had already said, in the Zoonomia and in an Additional Note to the poem, that "whenever the glandular system is stimulated into greater natural action within certain limits, an addition of pleasure is produced along with the increased secretion; this pleasure arising from the activity of the system is supposed to constitute the happiness of existence, in contradistinction to the ennui or taedium vitae."[5]

(1) T.N. IV. l.116.
(2) T.N. IV. ll.131-4.
(3) T.N. IV. l.140.
(4) T.N. IV. ll.145-50.
(5) T.N. Add.Note IX. p.40.

Existence is therefore a pleasure in itself. He now proceeds to enumerate the various pleasures which arise out of the activity of the sensorium, the fourfold operation of irritation, sensation, volition and association. Much of this consists of a recapitulation of material from <u>The Botanic Garden</u> and the first three cantos of <u>The Temple of Nature</u>. Thus, the pleasures of irritation, which is here equated with perception, are those of the senses, and those of Taste, as described in <u>The Progress of the Mind</u>. The pleasures of sensation are those of imagination, which result in the creations of the arts, deeds of patriotism, and the activities of philanthropy. Volition has given man reason and science, which have produced weapons, clothing, shelter, have taught man the use of fire and the cultivation of the ground. Newton, Herschel, Archimedes, Savery, inventor of the steam-engine, Isis, who discovered spinning and weaving, Arkwright, who in Darwin's own time had constructed a machine for spinning cotton, all represent the achievements of man's power of volition. Volition, too, gave language, and now,

> ". . . . . enlighten'd realms possess
> The learned labours of the immortal Press;
> Nursed on whose lap the births of science thrive,
> And rising Arts the wrecks of Time survive."[1]

---

(1) T.N. IV. ll.269-72.

At this point Darwin breaks into an impassioned plea for the freedom of the press. He calls upon upholders of liberty and justice:

> "Oh save, oh save, in this eventful hour
> The tree of knowledge from the axe of power;
> With fostering peace the suffering nations bless,
> And guard the freedom of the immortal Press!"[1]

Then, returning to his main theme, he recounts the pleasures derived from the power of association. Language, history, poetry, science, all the works of volition, depend equally upon association. So, too, the pleasures of sight depend on the association of this sense with that of touch. And from association arise the power of memory and the arts of dancing and music.

This part of the canto forms a good demonstration of the doubtful logic of Darwin's division of the operations of the sensorium into those of four faculties. Each of the four plays some part in nearly all the pleasures he describes; and it would be difficult to separate the operation of association, in particular, from that of each of the other three. This question, however, is not very relevant here. His purpose is to illustrate the happiness inherent in human life, and this the verse performs adequately.

---

(1) T.N. IV. 11.283-6.

All these pleasures, however, numerous as they are, are transitory. Old age and death supervene, and the organism perishes:

> "Soon the fair forms with vital being bless'd,
> Time's feeble children, lose the boon possess'd."[1]

The waste of life, meanwhile, is supplied by "births unnumber'd", who replace the parents:

> "And thus, alternating with death, fulfil
> The silent mandates of the Almighty Will;
> Whose hand unseen the works of nature dooms
> By laws unknown - WHO GIVES, AND WHO RESUMES."[2]

Darwin enlarges upon this theme. He explains that the oak scatters abroad thousands of acorns, the aphis reproduces itself in countless tribes, insects, frogs and fish produce innumerable young. Were there no counter-balancing force of destruction,

> "-All these, increasing by successive birth,
> Would each o'er people ocean, air, and earth."[3]

Nor is this true only of plants and animals:

> "So human progenies, if unrestrain'd,
> By climate friended, and by food sustain'd,
> O'er seas and soils, prolific hordes! would spread
> Erelong, and deluge their terraqueous bed;
> But war, and pestilence, disease, and dearth,
> Sweep the superfluous myriads from the earth."[4]

There is thus, throughout the organic world, a struggle for existence, a struggle between individuals,

---

(1) T.N. IV. 11.337-8.
(2) T.N. IV. 11.343-6.
(3) T.N. IV. 11.367-8.
(4) T.N. IV. 11.369-74.

between species, and against the forces of nature. On every side is cruelty, strife, destruction. The gloom is relieved, for those who survive, by the pleasures annexed to existence, but these pleasures are only for the few. The rest are "the superfluous myriads". Darwin comes very close here to stumbling upon the theory of natural selection which, in later years, his grandson evolved from an observation of these same facts. Charles Darwin, meditating upon the struggle for existence, and seeing that the fittest survive, deduced from the results of his observation the law of natural selection. Erasmus Darwin, well aware that the fittest do survive, just missed seeing the fact in the light which could have revealed its true significance, and so completed the theory of evolution which he had already worked out. What is interesting is that both grandfather and grandson may, in their considerations of the struggle for existence, have drawn upon the same source. In his autobiography Charles Darwin says:

> "In October 1838, that is, fifteen months after I had begun my systematic enquiry [into the transmutation of species], I happened to read for amusement 'Malthus on Population', and being well prepared to appreciate the struggle for existence which everywhere goes on from long-continued observation of the habits of animals and plants, it at once struck me that under these circumstances favourable variations would tend to be preserved, and unfavourable ones to be destroyed. The result of this would be the formation of new species."[1]

---

(1) The Life and Letters of Charles Darwin. ed. Frances Darwin. 1887. Vol.I. p.83.

An Essay on the Principle of Population, by Thomas Robert Malthus, was published in 1798. And it seems very possible that it was at least a contributory source of those passages of The Temple of Nature which are considered above. The theme of the Essay is that "the increase of population is necessarily limited by the means of subsistence."[1] In explanation of this statement Malthus declares:

> "Through the animal and vegetable kingdoms, nature has scattered the seeds of life abroad with the most profuse and liberal hand. She has been comparatively sparing in the room, and the nourishment necessary to rear them. The germs of existence contained in this spot of earth, with ample food, and ample room to expand in, would fill millions of worlds in the course of a few thousand years. Necessity, that imperious all pervading law of nature, restrains them within the prescribed bounds. The race of plants, and the race of animals shrink under this great restrictive law. And the race of man cannot, by any efforts of reason, escape from it. Among plants and animals its effects are waste of seed, sickness, and premature death. Among mankind, misery and vice."[2]

Again:

> "Famine seems to be the last, the most dreadful resource of nature. The power of population is so superior to the power in the earth to produce subsistence for man, that premature death must in some shape or other visit the human race. The vices of mankind are active and able ministers of depopulation. They are the precursors in the great army of destruction; and often finish the dreadful work themselves. But should they fail in this war of extermination, sickly seasons, epidemics, pestilence, and plague, advance in terrific array, and sweep off their thousands and ten thousands. Should success still be incomplete; gigantic inevitable famine stalks in the rear, and with one mighty blow, levels the population with the food of the world."[3]

---

(1) Thomas Robert Malthus. An Essay on the Principle of Population. 1798. p.140.
(2) Ibid., p.14.
(3) Ibid., p.139.

In view of these facts Malthus feels it incumbent upon him to "Vindicate the ways of God to man";[1] just as Darwin attempts "To prove to Man the Goodness of his God."[2] In the same way Thomas Balguy, whose Divine Benevolence Asserted, which Darwin knew, was published in 1781, had endeavoured to prove the benevolence of the deity in the face of apparent evidence of malevolence at work behind the laws of nature. Balguy had acknowledged that

> "Experience shews, that a variety of external causes are capable of destroying us. In the air, lightning, cold, heat, pestilence; on the earth, poisons, wild beasts, serpents: under the earth are laid up the materials, which produce eruptions and earthquakes: the water also may be fatal to land-animals: accidental causes are innumerable. Every part of nature contains, as it were, the seeds of destruction."[3]

The purpose of his pamphlet is to discover

> ".... whether the successive existence, perceptions, and actions, of the various animals which inhabit the globe, and the causes on which they depend, all of them proceeding from the intention of their maker, be reducible to a higher, or more general intention, viz. the production of happiness."[4]

In order to prove that the intention of the deity is the production of happiness, Balguy points to the pleasures man obtains through his senses, the pleasure which he derives from the exercise of his faculties, and which should be contrasted with "ennui" arising from indolence,

---

(1) Ibid., p.349.
(2) T.N. IV. 1.134.
(3) Thomas Balguy. Divine Benevolence Asserted. 1781. p.37.
(4) Ibid., p.15.

and the pleasures of the mind, resulting from man's powers of imagination, memory, reasoning, association.[1] It will be seen that this corresponds remarkably well with Darwin's conception of "the bliss of Being". Furthermore, Balguy attempts in a spirit of high optimism to prove that war and its consequent evils, death, hardship, poverty and hunger, is not the major disaster that it appears to be:

> "Whatever may be said of peaceful times, war, we are told, and the consequences of war, are fatal to multitudes. Many are deprived of all the comforts of life: many more of life itself; not only those who fall in the field, but those who are exposed, by military plunder, to nakedness and hunger, and perish for want of the necessary means of preservation."[2]

Life, however, must end in any case. Whether the end comes by a musket or a fever is not important. The dangers to which the victims of war are exposed, too, become familiar, and can thus be discounted. Poverty and slavery are hardships only to the rich and free. The generality of mankind are already poor, and must always labour. And it must not be forgotten that, although some may suffer from war, yet others derive advantage from it. Thus does Balguy assert divine benevolence. His assertion has, nevertheless, a possible relevance to The Temple of Nature.

Darwin, observing the continuous production and destruction of organic forms, recollects the fact of the circulation of matter, and exclaims:

---

(1) Ibid., p.39, ff.
(2) Ibid., p.117.

"HENCE when a Monarch or a mushroom dies,
Awhile extinct the organic matter lies;
But, as a few short hours or years revolve,
Alchemic powers the changing mass dissolve;
Born to new life unnumber'd insects pant,
New buds surround the microscopic plant;
Whose embryon senses, and unwearied frames,
Feel finer goads, and blush with purer flames;
Renascent joys from irritation spring,
Stretch the long root, or wave the aurelian wing.

When thus a squadron or an army yields,
And festering carnage loads the waves or fields;
When few from famines or from plague survive,
Or earthquakes swallow half a realm alive; -
While Nature sinks in Time's destructive storms,
The wrecks of death are but a change of forms;
Emerging matter from the grave returns,
Feels new desires, with new sensations burns;
With youth's first bloom a finer sense acquires,
And Loves and Pleasures fan the rising fires.-
Thus sainted PAUL 'O Death!' exulting cries,
'Where is thy sting? O Grave! thy victories?'"[1]

Thus happiness revives with life. So, Darwin continues, the phoenix revives from its ashes. So Pythagoras, from having observed the circulation of matter, taught the transmigration of souls. And thus he reduces myth, ancient religion, and Christian doctrine, to a law of science.

The whole of Darwin's argument in this canto is an amplification of an earlier statement of it in the Phytologia, published in 1800. In a section of this work to which, in a footnote, he refers his readers,[2] he had noted, first, that weaker organisms are continually destroyed by stronger:

---

(1) T.N. IV. 11.383-404.
(2) T,N. IV. 1.450, n. See Phytologia Part III. Sect. XIX. 7. 1.

> "Such is the condition of organic nature! whose first law might be expressed in the words, 'Eat or be eaten!' and which would seem to be one great slaughter-house, one universal scene of rapacity and injustice!"[1]

He then described, in some detail, the pleasures "which organized beings acquire from irritation only", and promised that "their happiness derived from imagination and volition may be treated of in some future work."[2] He further explained that, since old animals are transmigrated, by the circulation of matter, into young ones "the organized matter is taken from a state of less irritability and less sensibility, and converted into a state of greater."[3] He thus implies that there is an overbalance of pleasure. There follows a tentative suggestion:

> "A philosopher, whom I left in my library", Darwin remarks discreetly, "has perused the above paragraphs, and added the subsequent one to my manuscript."[4]

The paragraph in question advances the hypothetical destruction of a Russian army by the French forces. Then:

> "Forty thousand human creatures dragged from their homes and their connexions cease to exist, and have manured the earth; but the quantity of organized matter, of which they were composed, presently revives in the forms of millions of microscopic animals, vegetables, and insects, and afterwards of quadrupeds and men; the sum of whose happiness is perhaps much greater than that of the harassed soldiers, by whose destruction they have gained their existence! - Is not this a consoling idea to a mind of universal sympathy?"[5]

---

(1) <u>Phytologia</u>, p.556.
(2) Ibid.
(3) Ibid. p.557.
(4) Ibid., p.558.
(5) Ibid.

The "philosopher" then remarks "Having written the above, I fear you may think me a misanthrope", but declares, "Homo sum, humani nihil a me alienum puto."[1]

One might wonder, perhaps, whether Darwin, having read Balguy's argument for the benevolence of a deity who permits war, and remaining unconvinced by it, had not then sought some more realistic "justification" of the evils of war. Balguy's demonstration evinced optimism. Darwin's evinces both optimism and a scientific realism which gives it some basis. His solution of the problem of the existence of evil is an intellectual solution, and it is as a man of science that he arrives at it. He rejects the emotional consolations of religion, offered by St. Paul, and finds his own consolation in the power of the human mind to reflect, in complete detachment, upon the operation of the laws of nature. The Temple of Nature, which has been advanced as evidence of Darwin's theism, of his fundamentally religious attitude to life, seems to me, of all his works, that in which his agnosticism stands out most clearly. He speaks of the goodness of God, of 'The silent mandates of the Almighty Will';[2] and what he means is the working of natural laws which man, by the methods of science, may investigate and explain. To acknowledge that the pleasures of existence outweigh the pains is to

(1) Ibid., pp.558-9.
(2) T.N. IV. 1.134 and 1.344.

acknowledge a fact; it is nothing to do with religion. Whether Darwin himself was altogether conscious of these distinctions is perhaps another question. To the excesses of religion, he was certainly constitutionally opposed. In describing the "ideal ills" which man invents for himself, he comments:

> "Many theatric preachers among the Methodists successfully inculcate the fear of death and of Hell, and live luxuriously on the folly of their hearers."[1]

But his generation was accustomed to deplore the enthusiasm of the Methodists. Members of the Established Church itself tended to display towards their religion an attitude of moderate reasonableness, and to regard their deity as one whose ways could be explained and justified by commentary upon natural phenomena. Paley's watch has become a symbol of this mode of thought. Whether Darwin, who rejected the teleological principle in its strictest form in favour of the organism's gradual adaptation of itself to its environment under the stimulus of irritations and sensations, was completely aware of the gulf which divided him from the more scientifically minded among the orthodox, is not made clear by the poem. Though his attitude to religion, as reported by Mrs.Schimmelpenninck and others, seemed to the orthodox to leave much to be desired. It seems clear, at any rate, that he did not enter

---

(1) T.N. IV. 1.87, n.

deeply into philosophical speculation. His interests centred upon the inductive sciences, and beyond these, to final causes, he looked only in formality. His submission to the Almighty Will is a submission merely to unknown causes.

To these, however, he accords recognition in full. As the canto and his argument draw to their close he recapitulates the theory, set out in full in The Economy of Vegetation of the progressive formation of the strata of the earth from the remains of plants and animals. The earth itself is a record of the happiness enjoyed by organisms perished long since:

> "Thus the tall mountains, that emboss the lands,
> Huge isles of rock, and continents of sands,
> Whose dim extent eludes the inquiring sight,
> ARE MIGHTY MONUMENTS OF PAST DELIGHT;
> Shout round the globe, how Reproduction strives
> With vanquish'd Death, - and Happiness survives;
> How Life increasing peoples every clime,
> And young renascent Nature conquers Time;
> - And high in golden characters record
> The immense munificence of NATURE'S LORD! -"[1]

It seems possible that this insistence upon the happiness enjoyed by all forms of life may owe something to Thomas Percival's Speculations on the Perceptive Powers of Vegetables, which was published in the Memoirs of the Literary and Philosophical Society of Manchester, of which Darwin was a member, for 1784. Percival had said:

---

(1) T.N. IV. 11.447-56.

> ".... the idea of life naturally implies some degree of perceptivity; and wherever perception resides, a greater or less capacity for enjoyment seems to be its necessary adjunct. Indefinite and low, therefore, as this capacity may be, in each single herb or tree; yet when we consider the amazing extent of the vegetable kingdom.... the aggregate of happiness produced by it will be found to exceed our most enlarged conceptions."[1]

A little further on he declared:

> "For besides the various arguments which have been advanced in favour of vegetable perceptivity, it may be further urged, that the hypothesis recommends itself by its consonance to those higher analogies of nature, which lead us to conclude, that the greatest possible sum of happiness exists in the universe. The bottom of the ocean is overspread with plants of the most luxuriant magnitude. Immense regions of the earth are covered with perennial forests. Nor are the Alps, or the Andes, destitute of herbage, though buried in depths of snow. And can it be imagined, that such profusion of life subsists without the least sensation of enjoyment? Let us rather, with humble reverence, suppose, that vegetables participate, in some low degree, of the common allotment of vitality; and that our great Creator hath apportioned good to all living things, 'in number, weight and measure'."[2]

Darwin, however, was not convinced that the total sum of happiness was the greatest possible. He had observed, with an acuteness remarkable in its day, that

> "As the digested food of vegetables consists principally of sugar, and from this is produced again their mucilage, starch and oil, and since animals are sustained by these vegetable productions, it would seem that the sugar-making process carried on in vegetable vessels was the great source of life to all organized beings."[3]

---

(1) The Works, Literary, Moral, and Philosophical, of Thomas Percival, M.D. 1807. Vol.II. p.420.
(2) Ibid., p.430.
(3) T.N. IV. 1.66, n.

He therefore concludes that

> "..... if our improved chemistry should ever discover the art of making sugar from fossile or aerial matter without the assistance of vegetation, food for animals would then become as plentiful as water, and they might live upon the earth without preying on each other, as thick as blades of grass, with no restraint to their numbers but the want of local room."[1]

Man would thus repair the omissions of nature, and Malthus's proposition, that the increase of population is limited by the means of subsistence, would no longer hold good. That Darwin had been considering the whole problem for some years is evident from the fact that in a footnote to The Economy of Vegetation he mentions that Dr. Balguy has well evinced the benevolence of the great Author of all things, explains that the nourishment of animals is derived from three sources, from milk, from seeds and eggs, and from living animals and vegetables, and remarks:

> "But the last method of supporting animal bodies by the destruction of other living animals, as lions preying upon lambs, these upon living vegetables, and mankind upon them all, would appear to be a less perfect part of the economy of nature than those before mentioned, as contributing less to the general sum of happiness."[2]

The view that the less perfect parts of nature could be made perfect by human ingenuity sets Darwin against those who attempted to justify evil by emphasising its beneficial effects on character and morals. This was the

---

(1) Ibid.
(2) E.V. I. 1.278, n.

line Malthus took. It would be interesting to know whether Darwin would also have opposed the contention that, under existing conditions of strife, man was not a perfectible being. Malthus had confronted the perfectibilists with this argument. But there is every indication that Darwin had faith in the perfectibility of man, though not with any extravagant expectation of its early realisation. As an evolutionist he saw everywhere signs of progress towards perfection; but as a scientist he took a long view of history. And he admitted that this progress must finally cease. Noting the continual conversion of organic beings into solid parts of the earth's surface, he remarks:

> "But as those remains of former life are not again totally decomposed, or converted into their original elements, they supply more copious food to the succession of new animal or vegetable beings on their surface; which consists of materials convertible into nutriment with less labour or activity of the digestive powers; and hence the quantity or number of organized bodies, and their improvement in size, as well as their happiness, has been continually increasing, along with the solid parts of the globe; and will probably continue to increase, till the whole terraqueous sphere, and all that it inhabit shall dissolve by a general conflagration, and be again reduced to their elements.
>
> Thus all the suns, and the planets, which circle round them, may again sink into one central chaos; and may again by explosions produce a new world; which in process of time may resemble the present one, and at length again undergo the same catastrophe! these great events may be the result of the immutable laws impressed on matter by the Great Cause of Causes, Parent of Parents, Ens Entium."[1]

---

(1) T.N. IV. 1.453, n.

This is a scientist's revelation of the end of the world. It is to come in accordance with natural laws, and as a perished organism gives rise to new organisms, will eventually give rise to a new world. Urania's concluding words are a hymn of praise to the author of these laws:

"He gives and guides the sun's attractive force,
And steers the planets in their silver course;
With heat and light revives the golden day,
And breathes his spirit on organic clay;
With hand unseen directs the general cause
By firm immutable immortal laws."[1]

The poem ends with a procession of consecrated virgins to the temple and a hymn of adoration. At its close,

"- Slow to the altar fair URANIA bends
Her graceful march, the sacred steps ascends,
High in the midst the blazing censer stands,
And scatters incense with illumined hands:
Thrice to the GODDESS bows with solemn pause,
With trembling awe the mystic veil withdraws,
And, meekly kneeling on the gorgeous shrine,
Lifts her ecstatic eyes to TRUTH DIVINE."[2]

Divine truth is thus equated with the laws of nature. Darwin demands no more than this. His most earnest declaration of faith is a statement of belief in a chain of causes, and his deepest religious emotion is one of exultation in man's power to trace the links of the chain further and yet further back towards its origin. It is the faith and the religion of an age of optimism, and of one who looked upon the world with the dispassionate eyes of a man of intellect.

---

(1) T.N. IV. ll.457-62.
(2) T.N. IV. ll.517-24.

DARWIN THE POET

In preceding chapters Darwin's poetry has been considered chiefly as the expression in verse of the scientific knowledge of its age. The time has now come when it must be considered as poetry. But since Darwin's aim was "to inlist Imagination under the banner of Science",[1] it is only fair, to him and to his art, to treat him primarily as a poet of science, and to examine his verse, in somewhat closer detail than has so far been done, as the poetic expression of those facts and ideas which he purposed to convey. The first point to be discussed is, whether his verse does or does not perform adequately the task which he imposed upon it, or, in other words, whether it provides scientific instruction. Before considering this it is necessary to remember that the word "science" covers departments of learning which are specialised to varying degrees, which involve the use of terms more and less precise or technical, and which demand combinations in different proportions of simple observation, familiarity with experimental method and knowledge of the properties of the various forms of matter, together with the laws to which matter is subject. Since Darwin's subject-matter includes nearly the whole field of contemporary science, parts of it are necessarily more difficult than others to

(1) E.V. Advertisement. p.[V].

express in simple language, intelligible to the common reader, whether this is to be done in verse or prose. As an example of his treatment of an application of scientific knowledge of a simple but nevertheless fairly specialised type, which requires of the reader some acquaintance with certain scientific laws and certain properties of matter, we may consider his description of the pump:

> "NYMPHS! YOU first taught to pierce the secret caves
> Of humid earth, and lift her ponderous waves;
> Bade with quick stroke the sliding piston bear
> The viewless columns of incumbent air; -
> Press'd by the incumbent air the floods below,
> Through opening valves in foaming torrents flow,
> Foot after foot with lessen'd impulse move,
> And rising seek the vacancy above."-1

What is at first sight noticeable about this passage is the complete absence of that "gaudiness" which is commonly supposed to be the distinguishing mark of the Darwinian style. There is no word of colour, light or sound; there are no personifications of abstract qualities; and none of the more obvious examples of eighteenth century "poetic diction". The words which may be considered to belong to this diction, humid, ponderous, viewless, incumbent, floods, impulse, and vacancy, are chiefly of the class to which the label "Latinism" has been attached, but all these are used in their root English sense, with no

---

(1) E.V. III. 11.345-52.

added classical connotations. Each word and phrase of the passage, however, carries, in addition to its literal meaning, a specifically scientific significance,[1] and presupposes in the reader some knowledge of the fact or phenomenon which it describes. Some also bear wider associations. Thus, "the secret caves Of humid earth" would immediately suggest to those of Darwin's contemporaries who were interested in such problems the difficulties experienced, until the very recent application of Watt's steam-engine to the task, by those who attempted to drain mines of the water which flooded them. The word "ponderous" emphasises the main difficulty, the weight of the water to be removed. Similarly, "the viewless columns of incumbent air" remind the scientifically-informed reader of the discoveries of the previous century, that air, although invisible, had weight and pressure. It is this pressure which causes the water to rise into the vacuum, or "vacancy", created in the cylinder of the pump by the raising of the piston; and the fact that the floods "Foot after foot with lessen'd impulse move" is due to another fact, that the weight of the air is sufficient to balance the weight of

---

(1) Darwin's imposition of a specifically scientific meaning upon words of Latin derivation in common use should be compared with Johnson's application to common use of words with a primarily scientific significance. For discussion of Johnson's "philosophic" diction, see W.K. Wimsatt, Jr. The Prose Style of Samuel Johnson. Yale University Press. 1941. pp.59-62, 109-124.

only thirty-four (or about thirty-five, as given in Darwin's foot-note) feet of water, so that water cannot, by means of an ordinary pump, be raised above this level. With this background of knowledge, the reader must, as he reads the lines, visualise the cylinder of a pump, in which a horizontal bar, or piston, is slid up and down by means of a rod attached vertically to the centre of its upper surface. There is one passage through the piston, which is fitted with a valve. As the rod draws the piston upwards against the pressure of "the incumbent air", a vacuum is left below the piston. Into this vacuum rushes water, admitted through an inlet pipe inserted into the mass of water to be raised, and forced up the pipe by the pressure of the atmosphere on this mass of water. An "opening valve" in the pipe allows the water to enter the lower part of the cylinder. Then, as the piston is pushed down again, the other valve opens, and the water is forced through the piston into the upper part of the cylinder and is conducted away by an outlet pipe. It is doubtful, however, whether this is the picture which Darwin's lines would create in the mind of a reader who knew nothing of the pump and the principle on which it works. The footnote is enlightening, but not completely so. Darwin explains that the invention of the pump is ascribed to Ctesebes, an Athenian,

> ".... but it was long before it was known that the ascent of the piston lifted the superincumbent column of the atmosphere, and that then the pressure of the surrounding air on the surface of the well below forced the water up into the vacuum, and that on that account in the common lifting pump the water would rise only about thirty-five feet, as the weight of such a column of water was in general an equipoise to the surrounding atmosphere."[1]

He then accounts for the phrase "foaming torrents", which is used in the verse to describe the water which rushes into the vacuum:

> "The foamy appearance of water, when the pressure of the air over it is diminished, is owing to the expansion and escape of the air previously dissolved by it, or existing in its pores."[2]

To the reader who knew nothing of pumps, and who wished to be informed, a few sentences of prose and a diagram would be more helpful than these lines of verse and their footnote. Darwin's description would nevertheless be justified if it caused someone well acquainted with pumps to see them in a new light, if it added to the facts, which it embodies accurately enough, some significance beyond fact, and cast over them some poetic glow. This it can hardly be said to do. No associations, other than those of fact, are attached to the lines. They do not enrich the reader's experience in any way, other than by affording him some self-satisfaction at having deciphered what it all means. This is not even the pleasure to be derived from a

---

(1) E.V. III. 1.346, n.
(2) Ibid.

perception of the implications of a logical argument or of a striking juxtaposition of ideas. It gives us information which we already possess; or it forces us to take steps towards possessing it by supplementing from other sources those facts which can be grasped from the verse. This, to us, is not poetry. It is true, however, that to the majority of Darwin's contemporaries the art of poetry was a craft as well as an art. It was also a polite accomplishment; and an attempt to give neat expression in verse to material at first sight unpromising and intractable probably gave them a certain pleasure in skilled craftsmanship which is quite distinct from the satisfaction afforded by poetry.

Let us, however, examine another piece of instruction in verse, Darwin's account of the formation of the vegetable embryo:

"The Stamen males, with appetencies just,
Produce a formative prolific dust;
With apt propensities, the Styles recluse
Secrete a formative prolific juice;
These in the pericarp erewhile arrive,
Rush to each other and embrace alive.
- Form'd by new powers progressive parts succeed,
Join in one whole, and swell into a seed."[1]

This simply succeeds in conveying the supposed facts which form Darwin's theory of generation in more words than would be required in prose. The slight personification neither clarifies the idea, which is in any case straightforward, nor adds that touch of light humour which the same

(1) T.N. II. ll.271-78.

device had often given to The Loves of the Plants.

After this, a touch of gaudiness comes as something of a relief. We turn with gratitude to the Nymphs of Fire, who

"Ride, with broad eye and scintillating hair
The rapid Fire-ball through the midnight air;
Dart from the North on pale electric streams,
Fringing Night's sable robe with transient beams."[1]

This at least creates an immediately intelligible picture; and it takes only a second's thought to remember that Darwin is here assuming an electrical origin for the Northern Lights.[2]

The Nymphs of Fire, too,

"... arm in waves, electric in his ire,
The dread Gymnotus with ethereal fire.-
Onward his course with waving tail he helms,
And mimic lightenings scare the watery realms."[3]

This electric fish was a subject of some topical interest when these lines were written, and would probably be known, at least by report, to many of Darwin's readers. It is interesting to observe how, in this case, the conventional diction is endowed with precise scientific meanings. Thus "ethereal fire" is the imponderable fluid which was supposed to constitute electricity. And "mimic lightenings" not only creates a picture of the fish in action, but also has a literal meaning, since lightning was known to be of

---

(1) E.V. I. ll.127-30.
(2) See E.V. Add.Note.I. pp.3-5.
(3) E.V. I. ll.201-04.

an electrical nature, and the electrical discharge of the fish is actually a similar phenomenon, on a smaller scale.

If Darwin's description of the Gymnotus does not rise to the heights of inspiration, neither is it positively objectionable. Judged by the standards to which it was designed to conform it is, as a word-picture, effective. The trouble is, however, that it is not an example of a poetic device employed occasionally and with a particular purpose. The whole poem consists of similar word pictures, which are intended to present scientific information to the reader in an attractive form. And this kind of attractiveness becomes wearisome. The Economy of Vegetation, like Darwin's other poems, is loosely constructed. There is no organic development, resulting from a controlling purpose and a preconceived design. There is only progression along the line, often erratic, of Darwin's rapid but superficial thought. One is tempted to say that it is obvious why he placed such stress upon the importance to the human mind of the power of association. For the links between the successive sections of each canto, and between the topics, ideas and illustrations contained in each small section, are often tenuous in the extreme. Moreover the whole poem is on one level. It consists of an exposition of facts, real or suggested or presumed. All these facts, in accordance with the theory that "The Poet writes principally to the eye",[1] are conveyed in visual terms. Even without the theory, language as far as possible visual is an obvious means of communication of scientific phenomena, processes and objects. And from this procession of pictures there is little relief. When we come upon a picture that is drawn for its own sake and does not require us to consult notes or to think back to what we know of physics, or chemistry, or whatever it may be, we accept it thankfully and regard it with some favour. Thus the description, in the second canto of The Economy of Vegetation, of Venus Anadyomene[2], that of the Nereid on her sea-horse, in the third canto,[3] that of Cupid riding on a lion, in the fourth,[4] all arouse pleasure in the reader, though each one is overstated and over-elaborated. Darwin leaves nothing to chance or to the imagination. Every detail is there. Everything is highly wrought and highly polished. The total effect is nevertheless infinitely more pleasing than that which results from an attempt to turn intractable material, such as the action of the pump, into visual pictures.

It would thus appear that Darwin is most successful as a poet when he leaves science alone and gives free rein to his visual imagination. Indeed, The Loves of the Plants,

---

(1) L.P. Interlude I. p.48.
(2) E.V.II. ll.47-67. Darwin had evidently taken a hint for his description from Akenside. See The Pleasures of Imagination, 1744, Book I, ll.329-35. The Poetical Works of Mark Akenside. Aldine Edition. 1894. p.15.
(3) E.V.III. ll.277-96 (the lines are numbered incorrectly in the text).
(4) E.V. IV. ll.253-62.

in which there is comparatively little science, is the best of his poems. He presented it to his readers as a set of "diverse little pictures",[1] and this, in the main, it is. As an example of one of these pictures we might consider the description of a winter landscape, introduced as a simile into the second canto:

> "-Thus, when white Winter o'er the shivering clime
> Drives the still snow, or showers the silver rime;
> As the lone shepherd o'er the dazzling rocks
> Prints his steep step, and guides his vagrant flocks;
> Views the green holly veil'd in network nice,
> Her vermil clusters twinkling in the ice;
> Admires the lucid vales, and slumbering floods,
> Fantastic cataracts, and crystal woods,
> Transparent towns, with seas of milk between,
> And eyes with transport the refulgent scene:-
> If breaks the sunshine o'er the spangled trees,
> Or flits on tepid wing the western breeze,
> In liquid dews descends the transient glare,
> And all the glittering pageant melts in air."[2]

It was perhaps a half-unconscious recollection of some passage such as this that caused Coleridge to compare Darwin's work to "the Russian palace of ice, glittering, cold and transitory".[3] Here, however, that is precisely the effect at which Darwin was aiming. The piling up of words denoting whiteness, transparency, cold glitter, frozen immobility, creates a not unpleasing picture; the "green holly", with its "vermil clusters" provides the touch of contrast; and the soundlessness of the scene is well preserved. The only incongruous note occurs when Darwin

(1) L.P. Proem. p.[VIII].
(2) L.P.II. ll.333-46.
(3) Biographia Literaria. Chap.I. Everyman ed. 1939. p.10.

attempts to describe a human reaction. We cannot really believe that even an eighteenth century shepherd would "eye with transport the refulgent scene". This is where Darwin falls down. His accounts of human thoughts and feelings seldom ring true. And this is one reason why his lines rarely, if ever, rise above pleasing verse.

Not all Darwin's pictures are as successful as this. He is at his best when working upon something still - a landscape, Venus newly risen from the sea. When he attempts something in action, somebody in movement, the visual images lose particularity, and precise words of colour and form give way to a more general and conventional diction. Thus, the frozen scene described in the lines quoted above are followed by an account of the raising of an altar to Hygeia:

> "CINCHONA, fairest of Peruvian maids,
> To Health's bright Goddess in the breezy glades
> On Quito's temperate plain an altar rear'd,
> Trill'd the loud hymn, the solemn prayer preferr'd:
> Each balmy bud she cull'd, and honey'd flower,
> And hung with fragrant wreaths the sacred bower;
> Each pearly sea she search'd, and sparkling mine,
> And piled their treasures on the gorgeous shrine;
> Her suppliant voice for sickening Loxa raised,
> Sweet breath'd the gale, and bright the censor(sic) blazed".[1]

Darwin's use of "poetic diction" is, in general, no more ill-judged than that of many of his predecessors.

---

(1) L.P. II. 11.349-58.

He can, it is true, say that Hygeia "Gilt with her beamy eye the conscious shade";[1] he can tell us that a philanthropist, engaged in deeds of mercy, "with new life relumed the swimming eye".[2] But in particular contexts these excesses are not over-frequent. It is the relentless continuity, the employment of the same stock word or phrase for the same purpose, the perpetual dazzling of the mental eye, that wearies the most favourably disposed reader. And when to glaring or glittering colour is added movement, and emotion expressed in visual terms, the result is nearly always unfortunate. Thus, as Adonis rises from his sojourn underground, Venus is galvanised into action:

> "Long with broad eyes ecstatic BEAUTY stands,
> Heaves her white bosom, spreads her waxen hands;
> Then with loud shriek the panting Youth alarms,
> 'My Life! my Love!' and springs into his arms."[3]

The inadequacy of this method of portraying emotion ruins Darwin's attempts at the pathetic, the tender, or the horrid. He describes the fire which surprised the Molesworth family in their beds, and cries:

> "The trembling Nymph on bloodless fingers hung
> Eyes from the tottering wall the distant throng,
> With ceaseless shrieks her sleeping friends alarms,
> Drops with singed hair into her lover's arms."[4]

In the same way, the countless personifications that throng the pages of all three poems are made needlessly detailed and exaggerated. Darwin himself says:

---

(1) L.P. II. 1.383.
(2) L.P. II. 1.438.
(3) E.V.II. 11.607-10.
(4) E.V.III. 11.399-402.

"In poetry the personification or allegoric figure is generally indistinct, and therefore does not strike us so forcibly as to make us attend to its improbability."[1]

In The Temple of Nature, however, in a passage of verse which is intended to be melancholy in tone, he depicts Oblivion busily emptying the ashes from all the funeral urns he can lay hands on:

"Deep-whelm'd beneath, in vast sepulchral caves,
OBLIVION dwells amid unlabell'd graves;
The storied tomb, the laurell'd bust o'erturns,
And shakes their ashes from the mould'ring urns.-"[2]

For the modern reader these lines are not improved by the probably unconscious echo of Gray's "storied urn or animated bust". Darwin's plagiarisms, borrowings, echoes and references are numerous. He admits that he has "borrowed epithets, phrases, and even half a line occasionally from modern poems",[3] and argues, quite justifiably that "it may be difficult to mark the exact boundary of what should be termed plagiarism."[4] Many words and phrases come,naturally enough, from the common Miltonic stock. We do not feel particularly offended when we read, in the fourth canto of The Economy of Vegetation, that Proserpine

"Pluck'd with fair hand the silver-blossom'd bower,
And purpled mead, - herself a fairer flower."[5]

---

(1) L.P. Interlude I. p.49.
(2) T.N.I. ll.113-16.
(3) L.P Interlude III. p.139.
(4) Ibid.
(5) E.V. IV. ll.181-2. cf. Paradise Lost. Bk.IV. ll.268-72. See The Poetical Works of John Milton. ed. H.C.Beeching. [Oxford]. 1941. p.253.

It is possible, indeed, that recollection of Milton's lines adds to Darwin's account of the episode those qualities which it does not itself possess. Sometimes, too, a phrase is borrowed, one might suspect, for deliberate effect. Thus, in The Loves of the Plants, Arum, or Cuckow-pint, whose flowers form a tall red spike, is described as follows:

> "Stern ARA frowns, the measured march assumes,
> Trails her long lance, and nods her shadowy plumes;"[1]

This might recall, to the literary reader, Pope's description of Helenus, wounded by Menelaus:

> ". . . . . the wounded hand
> Trail'd the long lance that mark'd with blood the sand."[2]

The effect is less successful when Darwin converts Pope's description of Briareus, who "brandish'd round him all his hundred hands"[3] before the throne of Jove, into

> "With fierce distracted eye IMPATIENS stands,
> Swells her pale cheeks, and brandishes her hands,
> With rage and hate the astonish'd groves alarms,
> And hurls her infants from her frantic arms".[4]

For the note[5] explains that Impatiens, or touch me not, is a plant whose seed-dispersal depends on the contraction of the seed-vessel, and consequent ejection of the seed. In this instance Darwin's judgement has led him astray. Sometimes it is his taste which is at fault. Thus, the lines,

---

(1) L.P. IV. ll.285-6.
(2) The Iliad of Homer; translated from the Greek, by Alexander Pope, Esq. 1806. Bk.XIII. ll.747-48.Vol.II.p.30.
(3) Ibid. Bk.I. l.527.Vol.I. p.22.
(4) L.P. III. ll.131-134.
(5) L.P. III. l.131, n.

"With vain desires the pensive ALCEA burns,
And, like sad ELOISA, loves and mourns."[1]

which in themselves seem to contain a graceful and half humorous reference to Pope's Eloisa to Abelard, are amplified by a note which explains that in some double flowers "the petals become so numerous as totally to exclude the stamens, or males: as Caltha, Peonia, and Alcea; these produce no seeds, and are termed eunuchs".[2] Sometimes, however, Darwin can adapt successfully. Thus Thomson's "various twine of light"[3] suggests "untwist the sevenfold threads of light";[4] and Darwin's is perhaps the better of the two. When he tries to improve upon some of Shakespeare's better-known lines, the modern reader is bound to view the result with some prejudice. Thus, when

"And certain stars shot madly from their spheres,
To hear the sea-maid's music."[5]

is transformed, in Darwin's description of the Nereid upon her sea-horse, into

"And maddening Stars shoot headlong from the sphere."[6]

it is difficult to know how much of one's resentment is due to a conditioned attitude, and how far Darwin's version is really inferior. Frequently the reader's impression that he

---

(1) L.P.I. 11.69-70.
(2) L.P.I. 1.69, n.
(3) James Thomson. The Seasons. Spring. 1.211. See, The Complete Poetical Works of James Thomson. ed. J.L. Robertson. [Oxford.]. 1908. p.11.
(4) E.V. I. 1.118.
(5) A Midsummer Night's Dream. II. I. 153-54.
(6) E.V.III. 1.296.

is being cheated by false echoes is due to the fact that the whole context into which the borrowed phrase is inserted is little more than a burlesque of true poetry. Here, perhaps, Darwin's mistake is that he deprives the word "sphere" of the full significance which it bears in the original. This he very often does. In the first canto of The Loves of the Plants occur the lines,

> "Each pendant spider winds with fingers fine
> His ravel~~l~~'d ~~due~~ clue, and climbs along the line;"[1]

These leave a slight uneasiness in the mind. When, in The Economy of Vegetation, one comes upon another version, this uneasiness is increased:

> "So shoot the Spider-broods at breezy dawn
> Their glittering net-work o'er the autumnal lawn;
> From blade to blade connect with cordage fine
> The unbending grass, and live along the line;"[2]

One cannot but recall

> "The spider's touch, how exquisitely fine!
> Feels at each thread, and lives along the line."[3]

It is strange that Darwin, who had a special interest in the sense of touch possessed by certain insects, should so ignore the meaning of the original phrase, while preserving its pattern.

All these examples at least show how carefully, and to what purpose, Darwin had studied the work of his predecessors. He owes most to Pope, and he has caught the manner

---

(1) L.P. I. ll.477-78.
(2) E.V.III. ll.555-58.
(3) An Essay on Man. Epistle. I. ll.217-18. See The Poetical Works of Alexander Pope. ed. A.W.Ward. [Globe Edition]. 1930. p.198.

to such perfection that it has become mannerism. He has perfect technical control of versification, he knows all the phrases and epithets, and he possesses a lively fancy. And where his subject demands no more than these, he is competent. He lacks, however, that power of which Coleridge said:

> "It dissolves, diffuses, dissipates, in order to recreate: or where this process is rendered impossible, yet still at all events it struggles to idealize and to unify. It is essentially vital, even as all objects (as objects) are essentially fixed and dead."[1]

He has only "a mode of memory emancipated from the order of time and space."[2] It is, perhaps, doubtful whether, if Darwin had indeed been endowed with the creative imagination,he would have chosen the facts of science for the subject of poetry. It is difficult to see how even Coleridge could have dissolved and recreated a pump, and produced a lucid exposition of how it worked at the same time. Darwin's aims were first, to entertain, and second to instruct. In the first he was, in his own day, unquestionably successful. And if he did not succeed in conveying exact information in verse, he may well have aroused the interest of his readers in the topics with which he deals. He did not really ask more than this, and more than this we must not ask of him.

---

(1) S.T. Coleridge. Biographia Literaria Chapter XIII. [Everyman edition]. 1939. p.159.
(2) Ibid., p.160.

The fact nevertheless remains that his poems are structurally unsatisfactory. Thomas Campbell speaks justly when he says of The Economy of Vegetation:

> "The Rosicrucian machinery of his poem had, at the first glance, an imposing appearance, and the variety of his allusion was surprising. On a closer view it was observable that the Botanic goddess, and her Sylphs and Gnomes, were useless from their having no employment, and tiresome from being the mere pretexts for declamation."[1]

His criticism is sound. The presence of Sylphs or Gnomes does not forward the action, since there is no action which could not be performed without their aid. It merely necessitates a monotonous use of apostrophe and exhortation, so that the reader's ear is continually afflicted by the reiterated cry of "SYLPHS!". The machinery does, however, give a superficial unity to the widely assorted subject-matter of the poem. In The Loves of the Plants the Linnaean system performed this task. And The Temple of Nature has at least a rudimentary plan. The Economy of Vegetation, without its machinery, would be even more unco-ordinated than it already is. If Darwin had restricted himself to a much smaller field, and had attempted to expound only selected aspects of contemporary science, a more pleasing poem might have emerged. On the other hand, it might not, and as it is we have at least a wide view of one side of the life and interests and his

(1) Thomas Campbell. An Essay on English Poetry; with Notices of the British Poets. ed. P.Cunningham. 1848. p.431.

period. This is in itself an achievement, but it is an achievement which Darwin's immediate successors could not have been expected to appreciate. When Byron, therefore, speaks of

> ". . . . flimsy Darwin's pompous chime,
> That mighty master of unmeaning rhyme,
> Whose gilded cymbals, more adorn'd than clear,
> The eye delighted, but fatigued the ear;"[1]

we can sympathise with his point of view. For the modern reader the interest of Darwin's poetry is largely historical. And it is the interest aroused by a historical record of thought, of which science is a part, and of the social structure to which Darwin belonged, rather than by any significance which his work may possess in the history of literature. If we read his poetry for the science, we are sometimes agreeably surprised by an apt description or a pleasing picture. If we consider it as poetry, we tend to notice only the faults and at the same time to overlook the essential interest of the subject. We are best rewarded, then, by accepting Darwin as he wished to be accepted, as the poet of science.

---

(1) English Bards and Scotch Reviewers. ll.893-96. See The Poetical Works of Lord Byron. [Oxford]. 1945. p.124.

THE WORKS OF ERASMUS DARWIN

The Loves of the Plants.	1789.
The Economy of Vegetation.	1791.
Zoonomia.	Vol.I.1794. Vol.II. 1796.
A Plan for the Conduct of Female Education in Boarding Schools.	1797.
Phytologia.	1800.
The Temple of Nature.	1803.

Papers contributed to the Philosophical Transactions.

1) Remarks on the Opinion of Henry Eeles, Esq: concerning the Ascent of Vapour. Vol.L. Part I (1757).

2) An Uncommon Case of an Haemoptysis. LI. Part II, (1760).

3) Experiments on Animal Fluids in the exhausted Receiver. LXIV. (1774).

4) A New Case in Squinting. LXVIII. Part I. 1778.

5) An Account of an artificial Spring of Water. LXXV. (1785).

6) Frigorific Experiments on the Mechanical Expansion of Air. LXXVIII. (1788).

Experiments establishing a Criterion between Mucaginous and Purulent Matter and An Account of the Retrograde Motions of the Absorbent Vessels of Animal Bodies in some Diseases. Edited by Erasmus Darwin, with a life of his son Charles, the author.
1780.

His occasional poems are not listed here.

List of works referred to in the notes, prefaces, etc. (not including the Interludes of The Loves of the Plants) to Darwin's poems. Those to which direct reference has been made in the thesis are marked with an asterisk. Where Darwin does not make clear to which edition of a work he is referring, the date of the first, or, where stated, of the earliest available edition, is given in square brackets. Where an edition other than that quoted by him, or other than the first has been consulted, the details of this edition are underlined. There are a few references which it has not been possible to trace.

Achard.	Lettre .... Contenant la découverte qu'il a faite sur la formation des cristeaux & des pierres précieuses. Rozier. Observations sur la Physique. Vol.XI. (1778).
Adanson, Michel	A Voyage to Senegal. Trans. 1759.
Addison, Joseph	Spectator. No.62. The British Essayists. ed. James Ferguson. 1823. Vol.V.
* " "	Remarks on the Several Parts of Italy, &c., in the years 1701, 1702, 1703. [1705]. J.H.Moore. A New and Complete Collection of Voyages and Travels. 1785?
Anburey, Thomas	Travels through the Interior parts of America. 1789.
*Bacon, Francis	Works. 1778. The Works of Francis Bacon ed. Spedding, Ellis and Heath. 1870-75.
*Balguy, Thomas	Divine Benevolence Asserted. 1781.
Barbut, Jacques.	The Genera Vermium. 1783-88.
Barnes, Thomas	A New Method of Propagating Fruit Trees and Flowering Shrubs. 1759.
Beck, Henry J.le	An Account of the Pearl Fishery in the Gulf of Manar. William Nicholson. A Journal of Natural Philosophy, Chemistry and the Arts. April 1800.

Beckman, (Prof.)	Observations respecting Oysters. Philosophical Magazine. March, 1800.
Beddoes, Thomas	Observations on the Affinity between Granites and Basaltes. Philosophical Transactions LXXXI. (1791).
Belchier, John	An Account of the Bones of Animals being changed to a red Colour by Aliment only. Philosophical Transactions XXXIX. (1736).
*Bennet, Abraham	New Experiments on Electricity. 1789.
*Berkeley, George	An Essay towards a New Theory of Vision. 1709. Works. ed. A.C.Fraser. 1871.
Bertholon, (l'Abbé)	Nouvelles Expériences sur les effets de l'Electricité artificielle & naturelle, appliquée aux Végétaux. Rozier. Observations sur la Physique. Vol.XXXV. (1789).
Blagden, Charles	On the Heat of the Water in the Gulf Stream. Philosophical Transactions. LXXI. (1781).
* " "	An Account of some late fiery Meteors, with Observations. Philosophical Transactions. LXXIV. (1784).
Bonnet, Charles	Oeuvres d'Histoire Naturelle et de Philosophie. 1779-83. Also, Recherches sur l'Usage des feuilles dans les plantes. 1754.
*Bradley, Richard	A General Treatise of Husbandry and Gardening, 1726.
*Brownrigg, William	The Art of Making Common Salt. 1748.
*Broussonnet, -	Essai de Comparaison entre les Mouvements des Animaux et ceux des Plantes. Histoire de l'Académie Royale des Sciences. 1784.
*Bruce, James	Travels to discover the Source of the Nile. 1790.
*Bryant, Jacob.	A New System, or, an Analysis of Ancient Mythology. 1774.

Brydone, Patrick — Account of a fiery Meteor. Philosophical Transactions. LXIII. (1773).

*Buffon, Georges Louis Leclerc, Comte de — l'Histoire Naturelle [1749-88] Oeuvres Complètes. 1878.

*Bulliard, Pierre — Dictionnaire Élémentaire de Botanique. 1783.

*Burke, Edmund — A Philosophical Inquiry into the Origin of our Ideas of the Sublime and the Beautiful [1756]. Bohn. 1889.

Burmann, John — Thesaurus Zeylicanus. 1737.

*Burnet, James (Lord Monboddo) — Of the Origin and Progress of Language. [1773-92].

Cavendish, Henry — Experiments on Air. Philosophical Transactions. LXXV. (1785).

Cervantes Saavedra, Miguel de — Don Quixote.

*Chambers, Ephraim — Cyclopaedia, or an Universal Dictionary of Arts and Sciences. 1778.

*Claudian — Epithalium de Nuptiis Honorii Augusti. Loeb. 1922.

Cook, James — A Voyage to the Pacific Ocean ... in the years 1776-80. [1784.]

Cotes, Roger — Hydrostatical and Pneumatical Lectures 1738.

*Crawford, Adair — Experiments and Observations on Animal Heat. 1779.

Cronstedt, Axel F. — Essay towards a System of Mineralogy. Trans.Engeström, and revised by E.M. da Costa. 2nd ed. 1788.

Da Costa, E.M. — Elements of Conchology. 1776.

Dampier, William — Voyages and Adventures. 1776.

*Danet, Pierre — A complete Dictionary of Greek and Roman Antiquities, Made English. 1700.

*Darwin, E. An Account of an artificial Spring of Water. Philosophical Transactions. LXXV. (1785).

* " " Frigorific Experiments on the Mechanical Expansion of Air. Philosophical Transactions. LXXVIII. (1788).

* " " Experiments establishing a Criterion between Mucaginous and Purulent Matter and An Account of the Retrograde Motions of the Absorbent Vessels of Animal Bodies in some Diseases. (Written by Charles Darwin, eldest son of Erasmus. Edited, with a life of the author, by Erasmus Darwin). 1780.

*Darwin, Robert Waring (the younger) New Experiments on the Ocular Spectra of Light and Colours. Philosophical Transactions LXXVI. (1786).

*Defoe, Daniel Journal of the Plague Year. 1722. <u>Everyman, 1943</u>.

De Luc, Jean André A Second Paper concerning some Barometric Measures in the Mines of the Harz. Philosophical Transactions. LXIX (1779).

*" " " " First Letter to Dr. James Hutton. Monthly Review, June 1790.

De Mairan, - Nouvelles Recherches sur la Cause Générale du Chaud, en Été et du Froid en Hiver. Histoire de l'Académie Royale des Sciences. 1765.

De Thosse - Sur la manière de détruire les pucerons qui attaquent les arbres fruitiers. Mémoires d'Agricultures etc., publiés par la Société Royale d'Agriculture de Paris. 1787 (Trimestre de Printemps).

*De Tott, (Baron) Memoirs, translated from the French. 1786.

Dicquemarre, (l'Abbé) An Essay, towards elucidating the History of the Sea-Anemones. Philosophical Transactions LXIII (1773).

" " A Second Essay in the Natural History of the Sea Anemones. Philosophical Transactions LXV. (1775).

Dicquemarre,(l'Abbé) A Third Essay on Sea-Anemones. Philosophical Transactions. LXVII. (1777).

Dobson, Matthew An Account of the Harmattan. Philosophical Transactions LXXI (1781).

D'Ormoy - De l'Influence de l'Electricité sur la Végétation. Rozier. Observations sur la Physique. Vol.XXXV. (1781).

Du Halde, Jean Baptiste The General History of China. Trans. 1736.

Dwight, Timothy The Conquest of Canaan. [1785].

Ellis, John Remarks on Baster's Observations on Corallines, Polypus and other Sea-Animals. Philosophical Transactions L. (1757).

" " Extract of a Letter .... to Dr. Linnaeus, on the animal nature of the Zoophytes, called Corallina. Philosophical Transactions, LVII (1767).

* " " Observations on a particular Manner of Increase in the Animalcula of Vegetable Infusions. Philosophical Transactions LIX. (1769).

Encyclopaedia Britannica. 3rd ed. 1788-97.

*English Encyclopaedia 1802.

Evelyn, John Terra. ed. Alexander Hunter, 1778.

*Fabricius Vincentius Pestis Venere Curata. Miscellanea Curiosa Medico-Physica Academiae Naturae Curiosorum. Amus Secundus. (Dec.I) Jenae. 1671.

Falconer, William An Essay on Bath Waters. 1770.

Ferber, John James Travels through Italy in 1771 and 1772. Trans. 1776.

Fitzgerald, Keane Experiments on Checking the too Luxuriant Growth of Fruit Trees. Philosophical Transactions.LII (1761)

*Fitzgerald, Keane — Experiments with Chinese Hemp Seed. Philosophical Transactions LXXII. (1782).

*Foersch, N.P. — Description of the Poison-Tree in the Island of Java. London Magazine. Oct. 1784.

Foggini, N. — Museum Capitolinum. Vol.IV. 1782.

Fordyce, George — Elements of Agriculture and Vegetation. [1765].

*Franklin, Benjamin — Numerous unspecified references. See The Writings of Benjamin Franklin, Collected and Edited, with a Life and Introduction by Albert H. Smyth. 1907.

*Franklin, Brownrigg and Farish. — On the Stilling of the Waves by Means of Oil. 1774.

*Girtanner, Christopher — Memoir on Azot. Philosophical Magazine. May, 1800.

Gmelin, George — Flora Sibirica, sive Historia Plantarum Sibiriae. 1747-69.

Voyage en Sibérie. trans. 1767.

Goldsmith, Oliver — An History of the Earth and Animated Nature, 1774.

*Gori, Antonio Francesco — Museum Etruscum. 1737-43.

* " " " — Museum Florentinum. 1731-66.

*Grew, Nehemiah — The Anatomy of Plants. 1682.

Grey, Richard — Memoria Technica. [1730] 6th ed. 1781.

Haagren. - — Mémoire sur des Fleurs Donnant des Eclairs. Rozier. Observations sur la Physique. Vol.XXXIII.

*Hales, Stephen — Vegetable Staticks. 1727.

*Haller, Albrecht von — Elementa Physiologiae. [1759-66].

Halley, Edmund — On the true Theory of the Tides. Philosophical Transactions. XIX (1695).

Halley, Edmund	An Account of the late surprising Appearance of the Lights seen in the Air. Philosophical Transactions. XXIX. (1716).
*Hamilton, Hugh.	Philosophical Essays. [1767] 3rd.ed. 1772.
*Hamilton, William	Collection of Etruscan, Greek and Roman Antiquities. 1766-67.
Harris, John	Lexicon Technicum, or an Universal Dictionary of Arts and Sciences. [1704] 2nd ed. 1708.
Herodotus	Euterpe. Trans. G.C. Macauley. 1790.
*Herschel	Account of some Observations tending to investigate the Construction of the Heavens. Philosophical Transactions LXXIV (1784).
* "	On the Construction of the Heavens. Philosophical Transactions LXXV. (1785).
Hippocrates	Aphorisms.
Hitt, Thomas	A Treatise of Fruit Trees. [2nd ed.1757]
Hoepfner, -	Sur l'existence de cinq Terres simples dans les montagnes primitives. Annales de Chimie. Vol.I. (1789).
"	Observations sur la Combustibilité du Diamant. Rozier. Observations sur la Physique. Vol.XXXV. (1789).
Hogarth, William	The Analysis of Beauty, 1753.
*Hooke, Robert	Micrographia [1665].
" "	Philosophical Experiments and Observations. ed. W.Derham. 1726.
Hubert -	Sur l'Air contenu dans les cavités du Bambou. Rozier. Observations sur la Physique. Vol.XXXIII. (1788).
*Hugues, Pierre Francois (known as d'Hancarville)	Recherches sur l'Origine, l'Esprit et les Progrès des Arts de la Grèce. 1785.

*Hume, David	A Treatise of Human Nature. 1739. ed. T.H.Green and T.H.Grose. 1886.
Hunter, John	An Account of the Gymnotus Electricus. Philosophical Transactions LXV.(1775).
" "	Experiments on Animals and Vegetables with respect to the Power of producing Heat. Philosophical Transactions LXV. (1775).
" "	Of the Heat of Animals and Vegetables. Philosophical Transactions LXVIII. Part I. (1778).
*Hutton, James	The Theory of the Earth. 1785.
* " "	The Theory of Rain. Transactions of the Royal Society of Edinburgh. Vol.I. 1788.
*Ingenhousz, John	Experiments upon Vegetables. 1779.
Isert, Paul Erdmann	Voyage to Guinea. [Reise nach Guinea. 1788. Translated as Voyages en Guinée, 1793. No English translation in British Museum Catalogue].
Jacquin, Nicolaas Jozeph.	Hortus Botanicus Vindobonensis. 1770-76.
*Jerningham, Edward	Poems. 1786.
Johnson, Samuel	Dictionary [1755] 10th ed. 1792.
Kalm, Peter	Travels in North America. Trans. 1772.
Keill, John	An Introduction to the true Astronomy. 4th ed. 1748.
Keir, James	On the Crystallizations observed on Glass. Philosophical Transactions. LXVI. (1776).
* " "	A Dictionary of Chemistry. 1789.
Kircher, Athanasius	Musurgia Universalis. 1650.
Kennedy, John	A Treatise upon Planting, Gardening, and the Management of Hothouses. [1776].
*Kippis, Andrew.(ed).	Biographia Britannica. 1778.

*Kirwan, Richard	Elements of Mineralogy. 1784.
* " "	Estimate of the Temperature of different Latitudes. 1787.
* " "	An Essay on the Variations of the Barometer. Transactions of the Royal Irish Academy. Vol.II. 1788.
Lavoisier, Antoine Laurent	Mémoire dans lequel on a pour objet de prouver que l'Eau n'est point une substance simple. Histoire de l'Académie des Sciences. 1781.
* " "	Traité Élémentaire de Chimie. 1789. Trans. as The Elements of Chemistry. Robert Kerr. 1790.
Lewis, W.	Commercium Philosophico-Technicum. 1763-66.
Linnaeus, Carl	Systema Naturae. [1735].
" "	Systema Vegetabilium. ed. A.J.Murray. 1774.
* " "	Philosophia Botanica. [1751]. Trans. as The Elements of Botany. Hugh Rose. 1775.
" "	Species Plantarum. ed. D.J.J.Reichard. 1779-80.
* " "	The System of Vegetables. Trans. 1783.
* " "	The Families of Plants. Trans. 1787.
" "	Amoenitates Academiae. 1749-90 Vol.I. Peloria. D.Rudberg. Sponsalia Plantarum. J.G. Wahlbom. Vol.II. Oeconomia Naturae. I.J.Biberg. Vol.VI. Generatio Ambigena. C.L. Ramström. Theses Medicae. J.C.D.Shreber. Fundamentum Fructificationis. J.M.Gråberg. Prolepsis Plantarum. J.J. Ferber.

	Vol.VII.	Fundamenta Entomologia. A.J. Bladh.
		Raria Norwegia. H.Tonning.
Lowth, Robert		A Short Introduction to English Grammar. [1762].
Lowthorp, John		Philosophical Transactions Abridged. 1705, 1716. (Various brief references).
*Lucretius.		De Rerum Natura. ed. Cyril Bailey. 1947.
*Macquart, L.C.H.		Essais, ou Recueil de Mémoires sur Plusieurs Points de Minéralogie. 1789.
*Macquer, P.J.		A Dictionary of Chemistry. Translated, with additions, by James Keir. 1771.
Marsden, William.		Account of a Phenomenon observed upon the Island of Sumatra. Philosophical Transactions LXXI (1781).
*Martyn, Thomas		Letters on the Elements of Botany. 1785. (translated from J.J. Rousseau.)
Maskelyne, Nevil		A Proposal for measuring the Attraction of some Hill in this Kingdom by Astronomical Observations. Philosophical Transactions LXV. (1775).
" "		An Account of Observations made on the Mountain Schehallien for finding its Attraction. Philosophical Transactions. LXV. (1775).
" "		Advertisement of the expected Return of the Comet of 1532 and 1661, in the Year 1788. Philosophical Transactions. LXXVI. (1786).
Melville, Thomas		Observations on Light and Colours. Essays and Observations, Physical and Literary, Read before a Society in Edinburgh, and published by them. 1756. Vol.II. Art.IV.
*Michell, John.		A Treatise of Artificial Magnets [1750]. 2nd ed. 1751.
* " "		Conjectures concerning the Cause, and Observations upon the Phaenomena of Earthquakes. Philosophical Transactions LI. Part II. (1760).

Middleton, Christopher	The Effects of Cold .... at Prince of Wales's Fort. Philosophical Transactions. XLII. (1742).
*Miller, Philip	The Gardeners Dictionary. [1731-9] 7th ed. 1759.
*Milne, Colin	A Botanical Dictionary. 1770.
*Molina, G.I.	Essai sur l'Histoire Naturelle de Chili. trans. Gruvel. 1789.
Monge.	Mémoire sur la Cause des Principaux Phénomènes de la Météorologie. Annales de Chimie. Vol.V. (1790).
Monro, Alexander	The Structure and Physiology of Fishes. 1785.
Montfaucon, Bernard de	Antiquité Expliquée [1719].
Morgan, M.	Observations and Experiments on the Light of Bodies in a State of Combustion. Philosophical Transactions. LXXV. (1785).
Müller, O.F.	Animalcula Infusoria Fluviatilia et Marina. 1786.
*Mundy, Francis Noel Clarke	Needwood Forest. 1776.
Nicholson, William	First Principles of Chemistry. 1789.
*Ovid.	Metamorphoses. ed. R.Ehwald. Leipsic. 1903-8. Also Trans. T.Riley. Bohn. 1861.
Paterson, William	An Account of a New Electrical Fish. Philosophical Transactions. LXXVI. (1786).
Pemberton, Henry	A View of Sir Isaac Newton's Philosophy. 1728.
Pennant, Thomas	The British Zoology. 1768-70.
*Pilkington, James	A View of the Present State of Derbyshire. 1789.

Pliny — Natural History. Loeb. 1938

*Pluche, Noël Antoine — Spectacle de la Nature [1732] trans. as Spectacle de la Nature; or, Nature Displayed. S. Humphreys. 8th ed. 1757.

* " " — Histoire du Ciel [1739-41] trans. as History of the Heavens. J.D. de Freval. 1741.

Pontedera, Julius — Anthologia, sive de Floris Natura. 1720.

Pownal, Thomas — Hydraulic and Nautical Observations on the Currents in the Atlantic Ocean. 1787.

*Priestley, Joseph — Experiments and Observations on Different Kinds of Air. 1790.

* " " — The History and Present State of Discoveries relating to Vision, Light and Colours. 1772.

*Pringle, John — Some Remarks upon the several Accounts of the fiery Meteor (which appeared on Sunday the 26th of November, 1758), and upon other such Bodies. Philosophical Transactions. LI. Part I. (1759).

Pryce, William — Mineralogia Cornubiensis. 1778.

Pulteney, Richard — A General View of the Writings of Linnaeus. 1781.

" " — Observations on the Economical Use of the Ranunculus aquatilis. Transactions of the Linnaean Society. Vol. V. 1800.

*Reid, Thomas — An Inquiry into the Human Mind, on the Principles of Common Sense. [1764].

*Sainte Croix, G.E.J. — Mémoires pour Servir à l' Histoire de la Religion Secrète des Anciens Peuples. 1784.

*Savary, Claude Etienne. — Letters on Egypt. Trans. 1787.

*Saussure, H.B. de. — Essais sur l'Hydrometrie. 1783.

Semple, George — A Treatise on Building in Water. 1776.

Shaw, G. and Nodder, F. Vivarium Naturae, or the Naturalist's Miscellany 1789-1813.

Sloane, Hans A Voyage to the Islands of Madera, Barbadoes, Nieves, St.Christopher, and Jamaica, with the Natural History of the last. 1707-25.

*Smith, Adam The Theory of Moral Sentiments. [1759]. <u>Works. ed. Dugald Stewart</u>. 1812.

*Smith, James Edward Some Observations on the Irritability of Vegetables. Philosophical Transactions. LXXVIII. (1788).

Smith, Robert A Compleat System of Opticks. 1738.

Spallanzani, Lazzaro Dissertations relative to the Natural History of Animals and Vegetables. Translated by Thomas Beddoes. 1784.

Sparrman, Anders. A Voyage to the Cape of Good Hope. Trans. 1785.

*Spence, Joseph Polymetis. 2nd ed. 1755.

Sterling, James Account of a remarkable darkness at Detroit, in America, October 19, 1762. Philosophical Transactions LIII. (1763).

Stillingfleet, Benjamin The Calendar of Flora, Swedish and English. 1761.

" " A Discourse on the Irritability of some Flowers. Translated from the Italian, 1767.

*Stockdale, John. (compiler). The Voyage of Governor Phillip to Botany Bay. 1789.

Struve. - Sur une nouvelle Théorie des sources salées et du roc salé. Histoire et Mémoires de la Société des Sciences Physiques de Lausanne. Vol.II. 1784-86. Pub. 1789.

*Tench, Watkin A Narrative of the Expedition to Botany Bay. 1789.

Tessier (l'Abbé) Expériences propres à développer les effets de la Lumière sur certaines Plantes. Histoire de l'Académie Royale des Sciences. 1783.

Thompson, Benjamin — Experiments on the Production of Dephlogisticated Air from Water with Various Substances. Philosophical Transactions. LXXVII. (1787).

*Tooke, Horne — Diversions of Purley. 1786. ed. R.Taylor. 1840.

Tooke, William — Russia, or a compleat Historical Account of all the Nations which compose that Empire. 1780-83.

Ulloa, Antonio de — A Voyage to South America.[Trans.1758].

Valmont de Bomaré.J.C. — Dictionnaire Raisonné Universel d'Histoire Naturelle.[2nd ed.1775].

*Virgil — Aeneid. ed. J.W.Mackail. 1930.

" — Georgics. ed. Wagner. 1830.

*Volney, C.F. de — Travels through Syria and Egypt. Trans. 1787.

Von Troil, Uno. — Letters on Iceland. [1780].

*Walker, John — Experiments on the Motion of Sap in Trees. Transactions of the Royal Society of Edinburgh. Vol.I. 1788.

Walsh, John — Of the electric Property of the Torpedo. Philosophical Transactions. LXIII. (1773).

*Warburton, William — The Divine Legation of Moses. 4th edition. 1755-88.

Watson, Richard — Chemical Essays. [1781-87].

*Wedgwood, Josiah — Account of the Barberini, now Portland Vase. 1788?

White, Gilbert — The Natural History of Selborne. 1788.

*Whitehurst, John — An Inquiry into the Original State and Formation of the Earth. 2nd ed. 1786.

*Wilkins, John — An Essay towards a Real Character and a Philosophical Language. 1668.

Williams, Edward — Letter to Charles Hutton. Transactions of The Royal Society of Edinburgh. Vol.II. 1790.

*Williams, Helen Maria — Letters from France. 1790.

*Wilson. Alexander — Observations on the Solar Spots. Philosophical Transactions.LXIV. (1774).

" " — An Answer to the Objections stated by M.de la Lande, in the Memoirs of the French Academy for the Year 1776, against the Solar Spots being Excavations in the luminous Matter of the Sun, together with a short Examination of the Views entertained by him upon that Subject.
Philosophical Transactions,LXXIII.(1783).

Wilson, Benjamin — A Series of Experiments relating to Phosphori, 1775.

Wolfe, N.M. — Descriptio Fontis Hieronis. Philosophical Transactions LII.(1762).

Zimmerman. - — Voyage à la Nitrière naturelle qui se trouve à Molsetta. Rozier. Observations sur la Physique. XXXVI. (1790).

Analytical Review, — February 1790. Review of Cotte's Mémoires sur la Météorologie.Art XV.

Annual Register, — 1774, 1783, 1784, 1785, 1786.

The Critical Review — March 1788. Foreign Literary Intelligence.

The Gentleman's Magazine. 1763. 1782.

Medical Essays and Observations. By a Society in Edinburgh. 1737. Art.I. Meteorological Register.

Philosophical Magazine. May, 1801. Experiments and Remarks on Galvanism. (Anon).

Universal Museum. May. 1763. Account of Moskoesstrom.

The Following Works have also been Consulted

Anon.	A Collection of Old Ballads. 1723. (F.Roberts).
Anon.	The Golden Age. A Poetical Epistle from Erasmus D-N, M.D. to Thomas Beddoes, M.D. 1794.
Addison, Joseph	Spectator 519. The British Essayists. ed. James Fergusson. 1823. Vol.XI.
Akenside, Mark	Poetical Works. Aldine edition. 1894.
d'Assigny, Marius	A Short Collection of the Famous Mysteries of the Egyptians, Named Hieroglyphicks. 1671.
Bailly, Jean Silvain	Lettres sur l'origine des sciences, et sur celle des peuples de l'Asie. 1777.
Baker, Henry	The Microscope Made Easy. 5th ed. 1769.
" "	Employment for the Microscope. 2nd.ed.1764.
Banier, l'Abbé	Ovid's Metamorphoses, in Latin and English. Amsterdam. 1732.
Beddoes, Thomas	Alexander's Expedition down the Hydaspes and the Indus to the Indian Ocean. 1792.
" "	A Letter to Erasmus Darwin, M.D. on a New Method of treating Pulmonary Consumption. 1793.
Bemrose, William	The Life and Works of Joseph Wright. 1885.
Bolton, Henry C.	The Lunar Society. Transactions of the Birmingham and Midland Institute, Archaeological Section, for 1889.
Boothby, Brooke	Sorrows, sacred to the memory of Penelope. 1796.
Bradley, Richard	The Plague at Marseilles Consider'd.4th. ed. 1721.

Brandl, Leopold — Erasmus Darwin's Temple of Nature. Wiener Beiträge zur englischen Philologie. Band. 16. 1902.

" " — Erasmus Darwin's Botanic Garden. Wiener Beiträge zur englischen Philologie. Band 30. 1909.

Brown, James B. — Memoirs of the Public and Private Life of John Howard, the Philanthropist. 1818.

Brown, Thomas — Observations on the Zoonomia of Erasmus Darwin, M.D. 1798.

Burnet, Thomas — Archaeologicae Philosophicae. Trans. Foxton. 1729.

" " — The Sacred Theory of the Earth. 7th ed. 1759.

Butler, Samuel — Evolution Old and New. 2nd impression of 3rd ed. 1921.

Byron, George Gordon, Lord — Works. Oxford. 1945.

Campbell, Thomas — An Essay on English Poetry. ed. Cunningham. 1848.

Caylus, A.C.P. de Tubières, Comte de. — Recueil d'Antiquités. 1752-67.

Clarke, M.L. — Greek Studies in England, 1700-1830. 1945.

Coleridge, Samuel Taylor — Biographia Literaria. Everyman. 1939.

" " — Lectures and Notes on Shakspere and other English Poets. ed. T.Ashe. 1885.

Crabbe, George — Poetical Works. Oxford. 1908.

Cradock, J. — Literary and Miscellaneous Memoirs. 1828.

Dampier-Whetham, W.C.D. — A History of Science. 1930.

Darwin, Charles — Memoir of Erasmus Darwin, prefixed to E.Krause's Erasmus Darwin. 1879.

" " — Life and Letters. ed. Francis Darwin 3rd ed. 1887.

Darwin, Robert Waring(the elder) — Principia Botanica. 1787.

Dowson, John — Erasmus Darwin. 1861.

Edgeworth, Maria — Chosen Letters. ed. F.V.Barry. 1931.

Edgeworth, Richard Lovell — Memoirs ..... begun by himself and concluded by his daughter Maria Edgeworth 3rd ed. 1844.

Encyclopaedia Britannica — 14th edition.

Floyer, John — An Enquiry into the Right Use of Baths. 1697. Medicina Geronocomica. 1724-5.

French, R.N. — Poems and Sonnets. 2nd ed. 1813.

Geikie, Archibald — Memoir of John Michell. 1918.

Gilmour, John — British Botanists. Britain in Pictures. 1944.

Gurney, Thomas — Brachygraphy. 2nd ed. 1752.

Hadley. George. — Concerning the Cause of the General Trade Winds. Philosophical Transactions XXXIX. (1735)

Halley, Edmund — An Account of the Circulation of the Watry Vapours of the Sea, and of the Cause of Springs. Philosophical Transactions. XVII (1691).

Hartley, David — Observations on Man. 1749.

Helvetius, C.A. — De l'Esprit. Trans. 1759.

Herschel, William — On the Proper Motion of the Sun and Solar System. Philosophical Transactions. LXXIII (1783).

Home, Francis — The Principles of Agriculture and Vegetation. 1757.

Hungerford, Edward B. Shores of Darkness. Columbia University Press. 1941.

Hutton, Charles — Memoir of John Whitehurst, prefixed to Works, 1792.

Keir, James — A Treatise on the various kinds of Permanently Elastic Fluids or Gases. 1777.

Kirwan, Richard — Geological Essays. 1799.

Klingender, Francis D. — Art and the Industrial Revolution. 1947.

Krause, Ernst — The Scientific Works of Erasmus Darwin. Trans. W.S. Dallas. 1879.

L'Enclos, Ninon de — Memoirs. Trans. 1776.

Linnaeus, Carl — A Dissertation on the Sexes of Plants. Trans. James Edward Smith. 1786.

Locke, John — Philosophical Works. Bohn. 1885.

Logan, James V. — The Poetry and Aesthetics of Erasmus Darwin. Princeton Studies in English No.15. Princeton University Press. 1936.

Lovejoy, Arthur O. — Some Eighteenth Century Evolutionists. Popular Science Monthly. 1904.

" " — The Great Chain of Being. Harvard University Press. 1942.

Lowry, T.M. — Historical Introduction to Chemistry. 1915.

Lyons, Sir Henry — The Royal Society, 1660-1940. 1944.

Malthus, Thomas Robert. — An Essay on the Principle of Population. 1798.

Malebranche. — Treatise concerning the Search after Truth. Trans. T.Taylor, 1694.

Martyn, Thomas — Thirty-Eight Plates, with Explanations; intended to illustrate Linnaeus's System of Vegetables. 1788.

Maupertuis, P.L. Moreau de — Oeuvres. 1768.

McKillop, Alan D. — The Background of Thomson's Seasons. University of Minnesota Press. 1942.

Mead, Richard — Mechanical Account of Poisons. 1708.

" " — Discourse on the Plague. 1720.

Meteyard, Eliza — The Life of Josiah Wedgwood. 1865.

" " — Wedgwood and his Works. 1873.

Milton, John — Works. Oxford. 1941.

Moilliet, A. — Sketch of the Life of James Keir, Esq., F.R.S. ed. Alexander Blair. 1859.

Montague, Lady Mary Wortley — Letters and Works. ed. Wharncliffe. 1898.

Monthly Magazine. — June 1802. (Memoir of Erasmus Darwin).

" " — May 1804. (Miss Seward's retraction).

Muirhead, J.P. — The Life of James Watt. 1858.

Mundy, Francis Noel Clarke — The Fall of Needwood. 1808.

Nidecker, Henry — The Poetical Prelude of Erasmus Darwin's Second Marriage. 1935.

Pearson, Hesketh — Doctor Darwin. 1930.

Percival, Thomas — Works, Literary, Moral and Philosophical. 1807.

Pernéty, A.J. — Les Fables Égyptiennes et Grecques Dévoilées et réduites au même principe. 2nd ed. 1786.

Polwhele, Richard — The Unsex'd Females. 1798.

Pope, Alexander — Works. Globe. 1930.

" " — Homer. 1806.

Priestley, Joseph	The History and Present State of Electricity. 3rd ed. 1767.
" "	Scientific Correspondence. Ed. H.C. Bolton. 1892.
Pulteney, Richard	Historical and Biographical Sketches of the Progress of Botany in England. 1790.
Read, John	Prelude to Chemistry. 1936.
Rice-Oxley, L.	Poetry of the Anti-Jacobin. 1924.
Rutt, J.T.	Memoirs and Correspondence of Joseph Priestley. 1831-2.
Sachs, Julius von	History of Botany. trans. H.E.F.Garnsey. 1890.
Schimmelpenninck,M.A.	Autobiography. 1858.
Seward,A.C.(editor)	Darwin and Modern Science. 1909.
Seward, Anna	Memoirs of the Life of Dr.Darwin. 1804.
" "	Poetical Works. ed. W.Scott. 1810.
" "	Letters written between 1784 and 1807. ed. Constable. 1811.
Shaw, George Bernard	Back to Methuselah. World's Classics. 1945.
Shaw, Stebbing	The History and Antiquities of Staffordshire. 1798.
Singer, Charles	A Short History of Biology. 1931.
" "	A Short History of Science. 1941.
Smiles, Samuel	Lives of Boulton and Watt. 1865.
Smith, Adam	Works. ed. Dugald Stewart. 1812.
Stock, J.E.	Memoirs of the Life of Thomas Beddoes. 1811.
Temple, Sir William	Essays on Ancient and Modern Learning and on Poetry. ed. Spingarn. 1909.
Thomson, James	Poetical Works. Oxford. 1908.

Walpole, Horace	Letters. ed. Cunningham. 1861.
Wedgwood, Josiah	Catalogue of Cameos, Intaglios, Medals, etc. 6th ed. 1787.
Wimsatt, W.K. Jr.	The Prose Style of Samuel Johnson. Yale University Press. 1941.
Withering, William	A Botanical Arrangement of all the Vegetables naturally growing in Great Britain. 1776.
" "	Miscellaneous Tracts, edited, with a Memoir, by his son. 1822.
Wolf, Abraham	A History of Science, Technology and Philosophy in the 16th and 17th Centuries. 1935.
" "	A History of Science, Technology and Philosophy in the 18th Century. 1938.
The World	No. 29. The British Essayists. ed. James Ferguson. 1823. Vol.XXIII.
Wotton, William	Reflections upon Ancient and Modern Learning. 1694.