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ENGLISH
MEN OF SCIENCE

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Thomas H. Huxley;



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J. REYNOLDS GREEN, D.Sc.

THOMAS HENRY HUXLEY

ENGLISH MEN OF SCIENCE

Edited by J. REYNOLDS GREEN, D.Sc.

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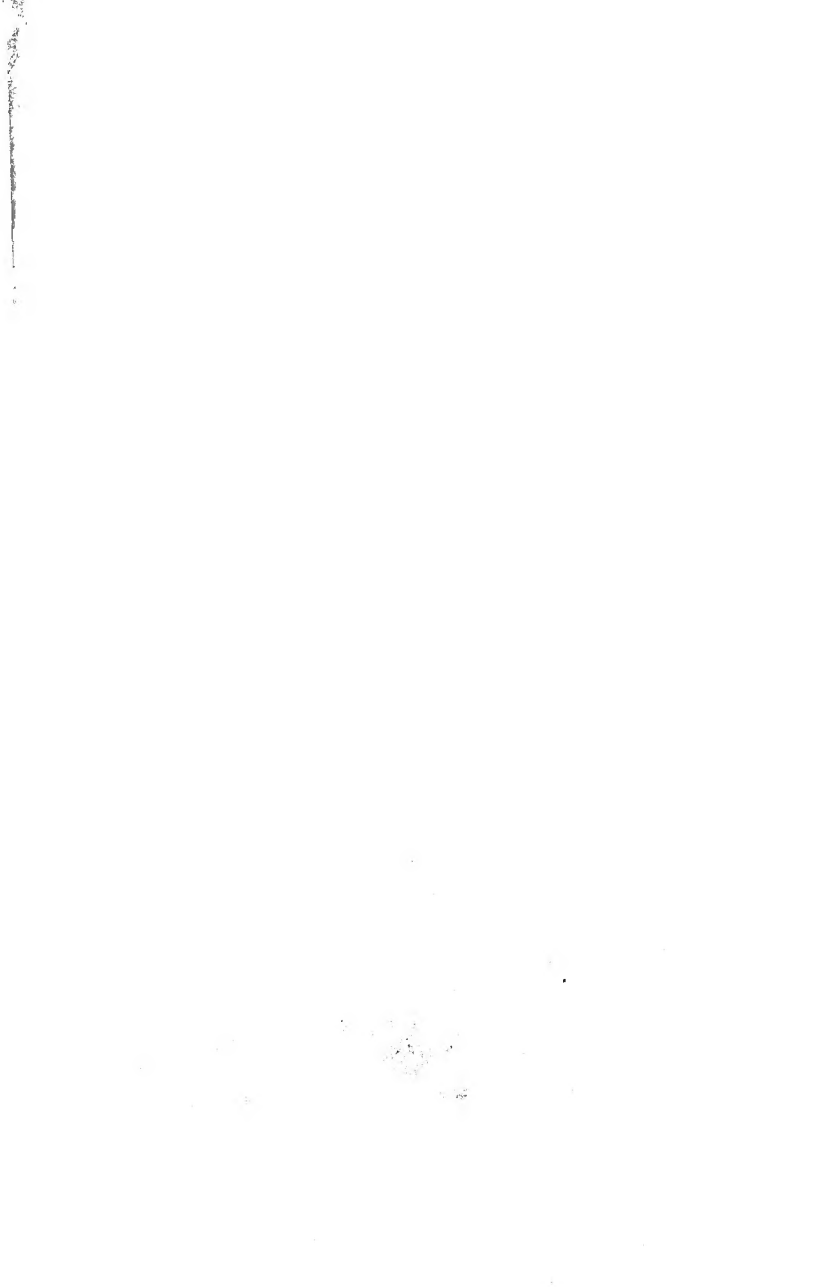
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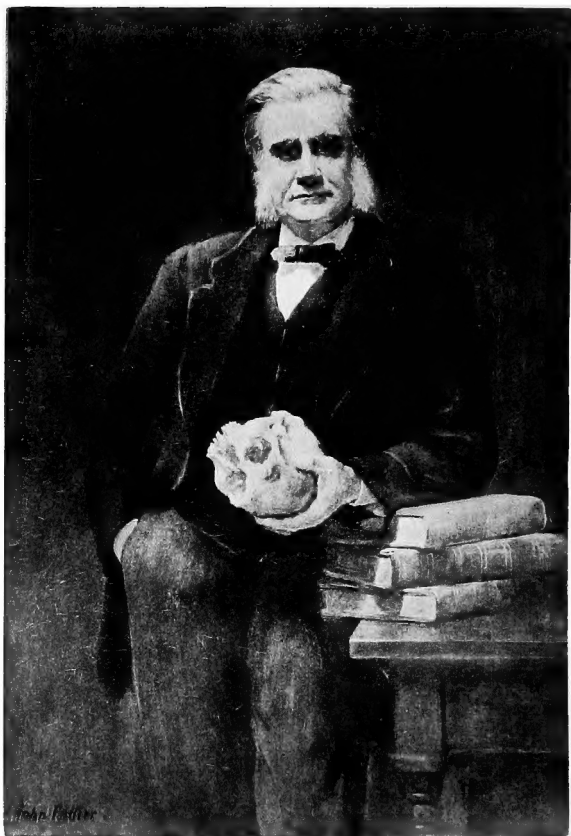


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J. H. Huxley

THOMAS H. HUXLEY

BY

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Trinity College, Cambridge



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1907

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“ To smite all humbugs, however big ; to give a nobler tone to science ; to set an example of abstinence from petty personal controversies, and of toleration for everything but lying ; to be indifferent as to whether the work is recognised as mine or not, so long as it is done :— are these my aims ? 1860 will show.

‘ Willst du dir ein hübsch Leben zimmern,
Musst dich ans Vergangene nicht bekümmern ;
Und wäre dir auch was Verloren,
Musst immer thun wie neugeboren.
Was jeder Tag will, sollst du fragen ;
Was jeder Tag will, wird er sagen.
Musst dich an eigenen Thun ergötzen ;
Was andere thun, das wirst du schätzen.
Besonders keinen Menschen hassen
Und das Übrige Gott überlassen.’” [GOETHE.]

(Last entry in T. H. Huxley's *Private Journal*,
December 31, 1856. *Life*, i, p. 151.)

PREFACE

AN attempt has been made in this short biography to bring into prominence Huxley's scientific work, though much of it was of so specialized a nature as to make a full presentment to other than professed zoologists practically impossible. It has been necessary to incur a large debt to Mr. Leonard Huxley's admirable *Life and Letters of Thomas Henry Huxley*, the chief source of information, and this is gratefully acknowledged. Reference has been made to the first edition, in two volumes (1900), the abbreviation "Life" being employed. In dealing with the published works, the Memorial Edition of the *Scientific Memoirs* (Sci. Mem.) and the nine volumes of *Collected Essays* (Coll. Essays) have been used wherever possible, as being most convenient.

J. R. AINSWORTH DAVIS.

ABERYSTWYTH, *December* 1906.

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Thomas Henry Huxley

CHAPTER I

EARLY LIFE AND TRAINING [1825-45].

THOMAS HENRY HUXLEY was born at Ealing on May 4, 1825, his father, George Huxley, being senior master in the well-known semi-public school of which Dr. Nicholas was then the head. Under the older name of Hodesleia the family can be traced back in Cheshire to the time of Richard I., but there is nothing in its annals foreshadowing the extraordinary eminence attained during the last half of the nineteenth century by its best known representative. So far as our information goes, Huxley was decidedly a "sport"—as he himself described the great Newton—a concrete illustration of the biological fact that variations of large amount may from time to time occur.

To the first volume of his *Collected Essays*, issued in 1893, Huxley prefixed a short *Autobiography*, originally written for another purpose, in which the bulk of his physical and mental characteristics are ascribed to inheritance from his mother. As to the former, he was tall, dark, and rather spare, with a commanding presence, and a striking though not handsome countenance, chiefly remarkable for breadth of forehead, prominence of chin, and a profusion of long straight hair. Huxley's most salient mental characteristics were absolute sincerity and

straightforwardness, unrivalled powers of criticism and generalization, and an equally remarkable faculty of rapid intuition, of which last he says: "If my time were to come over again, there is nothing I would less willingly part with than my inheritance of mother wit." To these must be added, as supposed endowments from the paternal side, a sufficiently hot temper, and a vast tenacity of purpose, "which unfriendly observers sometimes call obstinacy," but without which he could never have persisted in the upward climb to distinction which in its earlier stages often necessitated—to use his own phrase—"hanging on by the eyelids." From his father was inherited, too, the artistic power which rendered such signal service to his scientific work, and which made his lightning blackboard sketches during lecture both the despair and delight of his pupils. His artistic faculties also included an intense appreciation of music, which his strenuous life enabled him all too infrequently to gratify, as well as very strong literary tastes.

Had Huxley been the eldest child, he might perhaps have become an "infant phenomenon," but as the seventh, this stunting experience, fortunately for science and the world at large was spared him. His experience of "unreformed public school-life," between the ages of eight and ten, leaves little that is pleasant to record, the memory of a successful fight being the only illuminating spot.

In 1835 his father returned to the original home at Coventry, to become manager of a savings bank, and from this time on the boy's systematic school education seems practically to have come to an end. But this was far more than compensated by his passion for reading, and friendships contracted with older persons. For a boy of twelve to read—and appreciate—Hutton's *Geology*,

the forerunner of Lyell's *Principles*, seems sufficiently remarkable, but that he should, a little later, master Hamilton's *Logic*, is no less than astounding.

To this period we must refer the inception of Huxley's lifelong interest in philosophy, his ever manifest desire to get behind the facts, to reach bed-rock so far as possible. As a result of his association with his brother-in-law, Dr. Cooke, he now acquired his first direct interest in anatomy, and, most unfortunately, contracted blood-poisoning at a post-mortem examination, which dates the origin of digestive troubles that severely handicapped his entire career.

Among the works read by Huxley during his early teens were several of Carlyle's, and there can be no doubt that these exerted a profound influence upon his character, strengthening his natural tendency to despise all shams and humbugs, and to entertain high ideals of duty. It would also seem that they were of inestimable service in another respect, leading the young student to commence the study of German, a much neglected language in those days.

He also very early laid the foundation of a thorough knowledge of French and Italian. In later years his linguistic attainments were not only of the greatest service to him in the prosecution of his researches, but his example has effected a complete metamorphosis in the attitude of serious workers in the natural history sciences. Before Huxley's time the results of foreign research were often ignored or neglected. He first inaugurated the now universal custom of making bibliographical references and lists as complete as possible, whereby much overlapping and waste of energy have been averted.

Many if not most boys in their teens have some idea of what they would like to be, and Huxley was no

exception to the rule. We read in his *Autobiography* as follows:—

“As I grew older my great desire was to be a mechanical engineer, but the fates were against this, and, while very young, I commenced the study of medicine under a medical brother-in-law. . . . I am not sure that I have not all along been a sort of mechanical engineer in *partibus infidelium*. . . . The only part of my professional course which really and deeply interested me was physiology, which is the mechanical engineering of living machines . . . what I cared for was the architectural and engineering part of the business, *i.e.*, natural history, the working out the wonderful unity of plan in the thousands and thousands of diverse living constructions, and the modifications of similar apparatuses to serve diverse ends” (Coll. Essays, i, pp. 6-7).

In January, 1841, he went to Rotherhithe, and commenced his medical studies by becoming assistant to Dr. Chandler. He now for the first time came into contact with the very poor, and to this period we may refer the beginning of that marked interest in the working-classes, which afterwards bore fruit in his contributions to schemes for the improvement of elementary education, and in his numerous lectures to working men.

Somewhat later on, the young student of medicine was apprenticed to his brother-in-law, J. G. Scott, a doctor in North London, the husband of his eldest and favourite sister Lizzie, and took his first step towards graduation by beginning to prepare for the matriculation examination of London University, attending lectures at Sydenham College. His class successes were considerable, and included a silver medal for botany, given by the Apothecaries' Society, the winning of which, he afterwards declared, gave him more pleasure than the award of the Royal Society's Medal years later. We learn from an old diary kept during these years that in addition to examination studies and the pursuit of Ger-

man, he read the *Physiology* of the eminent Berlin professor, Johannes Müller, whose epoch-making comparative work in natural history he afterwards continued and extended with such brilliant success.

October 1, 1842, was an important date in the life of young Huxley, for, together with his brother James, he began his medical course at Charing Cross Hospital as a Free Scholar. Wharton Jones, the lecturer on physiology, undoubtedly made the most marked impression upon him, partly in virtue of his subject, but still more on account of his personality. Huxley's own opinion of himself as a man and as a student, at this epoch, was sufficiently pessimistic, and we may well allow ourselves to discount it altogether. The feature that most impressed his fellow-students was his extraordinary energy, one result of which was his first contribution to science, in the form of a paper entitled, "On a Hitherto Undescribed Structure in the Human Hair-sheath," published in the *London Medical Gazette* for July 1845 (Sci. Mem., i, 1, p. 1). The structure in question is still known as "Huxley's layer," and in the paper we find that the German literature is dealt with in characteristic fashion. It is given to but few medical students to make even small additions to the sum of scientific knowledge.

He passed through his student's course with marked distinction, taking a first prize in chemistry, as well as one in anatomy and physiology. For the two latter subjects he was awarded a gold medal, his place being second in honours in the M.B. examination of the University of London, 1845.

CHAPTER II

EXPERIENCES AS A NAVAL SURGEON ON THE "RATTLESNAKE" [1846-50].

THE chance suggestion made by Huxley's fellow-student Fayrer (afterwards Sir Joseph Fayrer) that he should apply for a post in the Medical Service of the Navy, determined his whole future career, and consequently had a momentous influence on the progress of scientific thought and research. Early in 1846 he entered the Navy, and was appointed to the *Victory*, for duty at Haslar Hospital, serving under Sir John Richardson, through whose recommendation he was transferred after some delay to the *Rattlesnake* frigate during October of the same year, in the capacity of assistant surgeon. It was also understood that he would co-operate with Macgillivray, the naturalist to the expedition. The ship was detailed for survey work in Australian and East Indian waters.

During the months that elapsed between the time the appointment was promised him (May) and that of departure (December), young Huxley with unremitting energy took every opportunity of fitting himself for the work of investigation before him. Owen, Gray, and particularly Edward Forbes, gave him much information and counsel which afterwards proved invaluable. Forbes, a pioneer in the art of dredging for scientific purposes, was especially friendly, sparing no pains in explaining the technical methods employed for the capture of marine animals. From him too Huxley

obtained a living specimen of the Lancelet (*Amphioxus lanceolatus*), for the purpose of investigating the nature of its blood, on which he read a short paper at the Meeting of the British Association, held that year at Southampton (Brit. Assoc. Rep., 1847, Part 2, p. 95. Sci. Mem., i, II, p. 4).

It is interesting to notice that Charles Darwin and Sir Joseph Dalton Hooker, who were afterwards among Huxley's most intimate friends, began, as he did, their scientific work on board ship, and given sufficient initial ability, there is much to be said for some such way of gaining horizon and wealth of imagination at the outset of a specialist career in natural history. There is at least no question that Huxley's early experiences in a ship of discovery were an important factor in giving that breadth of knowledge and interest by which he was so eminently characterized.

From letters of the period we learn that the young naturalist looked forward to the cruise with the most eager anticipation, and chafed at the delays which intervened between the promise of the appointment and the departure of the *Rattlesnake*. She at last left Spithead on December 3, 1846, and was away for four years, of which nearly three were spent in Australian waters. Professor Virchow in the Huxley Lecture for 1898, summarized the value of the training acquired in the following admirable way:—

“When Huxley himself left Charing Cross Hospital in 1846, he had enjoyed a rich measure of instruction in anatomy and physiology. Thus trained, he took the post of naval surgeon, and by the time that he returned, four years later, he had become a perfect zoologist and a keen-sighted ethnologist. How this was possible, any one will readily understand who knows from his own experience how great the value of personal observation is for the development of independent and unprejudiced thought.

For a young man who, besides collecting a rich treasure of positive knowledge, has practised dissection and the exercise of a critical judgment, a long sea-voyage and a peaceful sojourn among entirely new surroundings afford an invaluable opportunity for original work and deep reflection. Freed from the formalism of the schools, thrown upon the use of his own intellect, compelled to test each single object as regards properties and history, he soon forgets the dogmas of the prevailing system and becomes, first a sceptic, and then an investigator" (Times, Oct. 4, 1898).

Apart from the necessary appliances for marine surveying, her chief work, the scientific equipment of the *Rattlesnake* was nil, nor was she provided with any books of reference. This was only a part of the cheese-paring policy of the then Admiralty, which, as we shall see in the sequel, nearly led to Huxley's abandoning science as a profession altogether. But this sad lack of equipment only adds to the brilliance of the work effected under such trying and difficult conditions.

Regarding the routine details of Huxley's life on board ship we learn that congenial company largely atoned for inconvenient quarters, and his personal characteristics stood him in good stead. Kindly good-nature and equable spirits, combined with a saving sense of humour and entire absence of "side," will go far to avert friction, even among a band of cooped-up explorers.

After touching at Madeira, the *Rattlesnake* sailed to Rio de Janeiro, where dredging for marine animals began. Thence *viâ* the Cape and Mauritius to Hobart Town and Sydney, the last being reached on July 16, 1847.

Besides a paper on a rare bivalve mollusc of ancient type,¹ the scientific first fruits of the voyage were in the form of two memoirs, one on the "Anatomy of

¹ "Description of the Animal of Trigonina, from Actual Dissection" (Proc. Zool. Soc., xvii, 1849; and Annals and Mag. Nat. Hist., v, 1850. Sci. Mem., i, III, p. 6).

Physalia,"¹ the Portuguese man-of-war, a colonial jelly-fish (Proc. Linn. Soc., 1849), and the other "On the Anatomy and the Affinities of the Family of the *Medusæ*" (Phil. Trans. Roy. Soc., 1849, Part 2, p. 413. Sci. Mem., i, iv, p. 9). Several other memoirs² may be grouped with these, as well as the classical monograph on "The Oceanic Hydrozoa" (Ray Society, 1858), of which the publication was long delayed, owing to the penuriousness of the Government.

These publications deal with those lower organisms known to the older naturalists as "Zoophytes," and now technically named *Cœlentera*. They include hydroid zoophytes, medusæ or jelly-fishes, sea-anemones, corals, and various other forms. Until Huxley's time the systematics of this vast assemblage of apparently diverse types was in a state of the utmost chaos, the attention of previous workers having been chiefly devoted to description and naming of species without due comparison. The young navy surgeon reduced this chaos to order, and proved that a common plan of structure dominates the entire series. He demonstrated, in short, that the body of any one of these animals essentially consists of two cellular membranes, bounding variously shaped cavities, and suggested the equivalence of the said membranes to "the two primary germinal leaflets in the vertebrate embryo" (Prof. G. J. Allman, *Life*, i, p. 40).

¹ Brief notice only. The complete "Memoir on *Physalia*," op. cit., ii, 1855, pp. 3-5. Sci. Mem., i, xxxvi, p. 361.

² "On the Anatomy of *Diphyes*, and on the Unity of Composition of the *Diphyidæ* and *Physophoridæ*, etc." (Brief notice in Proc. Linn. Soc., 1849. Complete Memoir, op. cit., ii, 1855, pp. 67-9. Sci. Mem., i, xxxvii, p. 363).

"Notes on *Medusæ* and *Polypes*" (*Annals and Mag. Nat. Hist.*, vi, 1850. Sci. Mem., i, v, p. 33).

"*Ueber die Sexualorgane der Diphyidæ und Physophoridæ*" (Müller's *Archiv.*, 1851. Sci. Mem., i, xiv, p. 122).

These important generalizations constitute a firm foundation on which Haeckel and many other subsequent workers have built, and they in themselves are amply sufficient to give their author a prominent place in any philosophical history of zoology.

And when we remember that Huxley's scientific memoirs, published from 1845 to 1888 (inclusive), amount to no less than 170, ranging over the entire animal kingdom as well as including valuable ethnological work, and that many of them are of epoch-making character and will ever remain classical, our conceptions as to the vast industry and capacity of the man must be almost indefinitely enlarged.

In later years Huxley was so prominently before the public as a hard-hitting controversialist, especially on behalf of Darwinism and the higher criticism, possessed of unrivalled sardonic humour, that many are apt to regard him as of a somewhat unsympathetic nature. Such an idea, however, is entirely devoid of any solid foundation, for like so many independent and positive characters, he was extremely sensitive to the sympathy of others, and was himself warm-hearted and appreciative to a degree. It is somewhat unfortunate that a number of his pungent epigrams, thrown off in moments of irritation or as flashes of irrepressible sarcastic wit without thought of their perpetuation, have been preserved to give a totally wrong impression of his general character.

As for the advancement of science, so also for Huxley's private life, the voyage of the *Rattlesnake* proved to be of no small importance. For in Sydney he met, and became engaged to, his future wife, Miss Henrietta Anne Heathorn, his ideal union with whom was destined to endure for forty years. The eleven months spent from

first to last in Sydney afforded abundant opportunity for intimate mutual knowledge.

Apart from a short visit made to Bass's Strait, the *Rattlesnake* made three northern cruises, surveying the inshore Passage (between Australia and the Great Barrier Reef), and thence exploring Torres Straits, the Louisiade Archipelago and S.E. New Guinea. A westward extension of this work in the direction of Java and Sumatra was prevented by the premature death of the commander, Captain Owen Stanley. The ship finally left Australia for England in May, 1850, returning by way of the Falklands and Azores to Plymouth, and arriving at Chatham on November 9, of the same year.

In a letter to Sir John Richardson, dated October 31, 1850, Huxley summarizes his *Rattlesnake* work (Life, i, pp. 57-8), and the information there given is supplemented by his paper, "Zoological Notes and Observations made on board H.M.S. *Rattlesnake* during the years 1846-50" (Annals and Mag. Nat. Hist., Ser. 2, vii, 1851, pp. 304-6, and viii, 1851, pp. 433-42. Sci. Mem., i, ix, p. 80). Apart from the paper on Trigonina and the researches on Medusæ already mentioned, they include the following, of which the three first are embodied in the "Notes" just mentioned.

1. "Upon Thalassicola," an undescribed type of the Protozoa or simple unicellular animals, most of which are microscopic. In the middle of last century zoological classification was dominated by the views of Cuvier, who had established several large groups or subkingdoms, of which one was known as the "Radiata." This included a vast assemblage of heterogeneous forms, among which were Medusæ and their allies, Echinoderms (star-fishes, etc.), Entozoa (parasitic worms), Ascidians (sea-squirts), Bryozoa (moss-polypes), and the above-named

Protozoa, with which the sponges were then associated. One of Huxley's aims was to reduce the Radiata to order, breaking it up into smaller natural groups, and determining their affinities so far as possible.

His papers on Medusæ had succeeded in doing this for one large set of forms, and the paper now under discussion was not merely a description of a new animal, but also a successful attempt to define and delimit the Protozoa. Huxley's view, now (if sponges are excluded) universally accepted, that these are of relatively simple structure, directly traversed the authority of the celebrated Ehrenberg, already challenged by a number of distinguished naturalists.

2. "On the Anatomy of the Genus *Tethya*" (a sponge).

3. "On the Auditory Organs in the Crustacea."

The much-vexed question as to the position of these structures (to which another function is now ascribed) in the higher Crustacea, such as prawns and the like, is definitely settled in this paper.

4. "Observations sur la Circulation du Sang chez les Mollusques, des Genres *Firole* et *Atlante*" (Ann. des Sci. Nat., xiv, 1850, pp. 193-5. Sci. Mem., i, vi, p. 36).—Here we have a positive contribution to the physiology of certain pelagic snails, founded upon observations made on living specimens. Even at the present day physiological work on invertebrates is relatively scanty, and that so young a naturalist as Huxley then was should devote some time to it is one of many proofs of the wide nature of his interests.

5. "Observations on the Genus *Sagitta*" (Brit. Assoc. Rep., 1851. Sci. Mem., i, x, p. 96).—The little arrow-worms (*Sagitta*, etc.) occur in vast numbers in the floating population (plankton) of the sea, and their classificatory position is still a moot point. In this short paper

Huxley is inclined to associate them either with certain degenerate Crustacea, or with the Arachnida (scorpions, spiders, etc.), rather inclining to the latter view. But in his letter to Sir John Richardson he tentatively speaks of them as Annelids, or segmented worms.

6. "Observations upon the Anatomy and Physiology of *Salpa* and *Pyrosoma*" (Phil. Trans. Roy. Soc., 1851, Part 2, pp. 567-94. Annals and Mag. Nat. Hist., ix, 1852, pp. 242-4. Sci. Mem. i, vii, p. 38).

7. "Remarks upon Appendicularia and *Doliolum*, two Genera of the Tunicata" (Phil. Trans. Roy. Soc., 1851, Part 2, pp. 595-606. Sci. Mem., i, viii, p. 69).

The last two important memoirs deal with pelagic members of the Tunicata, Ascidians, or sea-squirts, animals which are now known to constitute a lowly group of the Vertebrata. Huxley largely added to our knowledge of their anatomy and physiology, and it does not detract from the merits of his work that parts of it had been anticipated. As in so many of his contributions to science the comparative method of Johannes Müller was applied with eminent success, and the work on *Salpa* was of especial interest. For earlier in the century Chamisso discovered in these creatures what he termed "alternation of generations," *i.e.*, the alternation of a sexual and an asexual stage in the same life-history, a phenomenon which is now known to be of frequent occurrence among plants and in several groups of animals. Huxley succeeded in placing Chamisso's conclusions on a firm basis, at the same time modifying and extending them.

While the memoirs now briefly dealt with, and some others to be subsequently mentioned, were the direct result of Huxley's voyage, the material collected and the observations then made led to other and later contributions to science.

In attempting to estimate the value of the earlier contributions to science it is of course necessary to bear in mind the backward state of many departments of natural history, and the relatively crude nature of biological technique compared with its present condition, especially as regards microscopes, section-cutting and the like.

CHAPTER III

SUCSESSES AND FAILURE [1850-4].

FROM the return of the *Rattlesnake* till 1854 Huxley's career was scientifically a brilliant success, but otherwise a long series of disappointments, not unmixed with family sorrow. In 1849 the Admiralty had promised him either rapid promotion or financial aid in the publication of his scientific work, but neither promise was redeemed. In spite of the backing of many influential friends, including Sir John Richardson, Prof. Owen and Prof. Edward Forbes, the concessions granted him practically amounted to leave of absence for three years and a half, these being largely spent in working out his results, as embodied in the memoirs dealt with in the last chapter, and in preparation of the monograph on "The Oceanic Hydrozoa," to publish which the Government Grant was needed.

The matter came to a head when he applied for a further extension of leave in January 1854, the answer to which was an order to join the *Illustrious* at Portsmouth. Failing to comply with this, he was finally struck off the Navy List in the following March. Not only did he fail in getting the promised aid for publication from the Admiralty, but, for purely technical reasons, the Royal Society was unable to allot him a portion of the annual Government Research Grant for this end.

During these years Huxley was also unsuccessful in applications successively made for chairs in Toronto,

Aberdeen, Cork, and King's College, London. And in the middle of this depressing period the death of his mother, which took place in April 1852, overwhelmed him with the most profound sorrow. At this time he was sorely tempted to abandon science as a profession altogether, and but for the encouragement of his sister Lizzie and the unwavering trust and devotion of Miss Heathorn, might perhaps have done so.

Huxley's many occasions for despondency began to be augmented in 1852 by professional jealousies, and by attempts, luckily unsuccessful, to retard his further progress. Then, as always, he proved himself a perfectly straightforward antagonist, but at the same time one whom it was decidedly unpleasant to tackle.

There is fortunately a reverse side to the picture, constituted by the immediate result of his scientific work, and the friendships contracted during this somewhat depressing period of his life. His memoirs on the *Medusæ* and their allies, published during his absence from England, placed him at once in the foremost rank of scientific workers, and on June 5, 1851, he was elected a Fellow of the Royal Society, being one of fifteen selected from a list of thirty-eight candidates, no small distinction for a young man but just turned twenty-six. And this was the result of sheer merit, untainted by the slightest intrigue. The distinction was very nearly increased by the award of the Royal Medal, which, however, went to the veteran naturalist, Newport, whose work was more voluminous but not of better quality. Though naturally proud and pleased at such recognition, it would seem that Huxley's pleasure was somewhat tempered by reflections as to the dearth of scientific posts in Britain, and the comparatively unremunerative nature of such as existed.

The unsatisfactory attitude of the Admiralty, and uncertainty as to prospects in general, stimulated rather than diminished the output of scientific work at this time. The memoir on *Medusæ* (which gained him the F.R.S.), and the account of *Trigonia*, were published during the cruise of the *Rattlesnake*. By the end of 1851 the papers mentioned in the last chapter were completed, and also the following :—

1. "Report upon the Researches of Prof. Müller into the Anatomy and Development of the Echinoderms" (*Annals and Mag. Nat. Hist.*, Ser. 2, viii, 1851, pp. 1-19. *Sci. Mem.*, i, XIII, p. 103).—After summarizing seven memoirs written by Müller (1846-51), Huxley endeavours to show that the animals under discussion (star-fishes, sea-urchins, etc.) furnish an illustration of "alternation of generations," and discussed the meaning to be attached in zoology to the term "individual," defining it as "the total result of the development of a single ovum, whether this total result consist of one or many independent existences." Here, as in so many other instances, his strong interest in the philosophical side of natural history is shown in a striking manner.

2. "On *Lacinularia socialis*, a Contribution to the Anatomy and Physiology of the Rotifera" (*Trans. Micros. Soc. London, New Ser.*, i, 1853, pp. 1-19. Read Dec. 31, 1851. *Sci. Mem.*, i, xv, p. 126). This memoir gives an exhaustive account of a wheel-animalcule common in the Medway, and compares it with other members of the group, the affinities of which are discussed. That the Rotifera must be removed from the Radiata is clearly proved, but the view that they should be closely associated with Echinoderms, was subsequently modified. To this day the real affinities of wheel-animalcules remain a matter of doubt.

Huxley had already commenced his long friendship with Hooker, and that with Tyndall began in connection with the British Association Meeting of 1851, held at Ipswich. His close intimacy with these two fellow-workers had no small influence upon his career, and meant very much in many crises of his after life. To the lay public, "Huxley and Tyndall" long stood for science at large, as well as for scientific heterodoxy.

The following scientific memoirs appeared in 1852:—

1. "On the Anatomy and Development of *Echinococcus veterinorum*" (Proc. Zool. Soc., xx, 1852, pp. 110-26. Sci. Mem., i, xix, p. 197).—This is an important contribution to the morphology of yet another animal group, the tape-worms (Cestoda), part of the heterogeneous assemblage of parasitic forms, which, under the name of Entozoa, were included in the Radiata. Huxley minutely described the tape-worm stage known as *Echinococcus*, which is found as a large compound cyst in the liver of various hoofed mammals (and at times in man), and compared it with the simpler cysts of other tape-worms. His work and that of Von Siebold's (quoted in this paper) established beyond question that the cyst in question is an earlier stage in the life-history of a tape-worm which infests the intestine of the dog.

2. "Researches into the Structure of the Ascidians" (Brit. Assoc. Rep., 1852, pp. 76-7. Sci. Mem., i, xviii, p. 194).—Huxley's previous researches upon Ascidians (Tunicates) had given him a unique knowledge of the group, and this short communication embodies various conclusions arrived at when cataloguing the British Museum collection. It is particularly noteworthy that he compares the branchial sac of Ascidians with the perforated pharynx of the Lancelet (*Amphioxus*), for this foreshadows the brilliant discovery subsequently made by Kowalewsky

that Ascidians are not invertebrates but members of the great sub-kingdom of back-boned animals. He also confirms previous statements that the "test" or firm investment which characterizes members of the group contains cellulose, a substance once thought to be peculiar to plants, and of which cotton may be taken as a good example.

3. "On the Morphology of the Cephalous Mollusca, as illustrated by the Anatomy of certain Heteropoda and Pteropoda collected during the voyage of H.M.S. *Rattlesnake* in 1846-50" (Phil. Trans. Roy. Soc., cxliii, 1853, pp. 29-66. Read at the Brit. Assoc. Meeting of 1852. Sci. Mem., i, xvii, p. 152).—The "cephalous" Mollusca are those which possess a distinct head, *e.g.*, cuttle-fishes and snails, and the groups named include pelagic animals belonging to the latter category. After remarking on the unsatisfactory state of knowledge as regards Mollusca, the author says that this appears,—

"to result from two causes;—first, from the want of a clear and definite conception of the fundamental varieties of molluscous structure, and of the nature of the changes in the relations of parts which constitute those varieties; and secondly, from the want of a due regard to the facts presented by the development of the various families, which must stand in the relation of cause to the varieties of form.

"Now in order to the former end (the obtaining of a definite conception of the varieties of molluscous form), I propose to set forth the structure of certain *Heteropoda* and *Pteropoda*; pelagic animals so transparent, that a perfect knowledge of the arrangement of their parts may be arrived at by simple inspection, without so much as interrupting a beat of their heart.

"Afterwards, I shall inquire how far the known laws of development account for these forms, and thence of what archetypal form they may be supposed to be modifications."

Many additions to our knowledge were made in the descriptive part of this memoir, though the mistaken

account of the mode of action of the rasping-organ (odontophore) has been taken over implicitly by many subsequent observers. But the theoretical matter is of much greater interest, endeavouring as it does to explain various molluscan forms as variants of the same primitive type, which is reconstructed in detail. The particular molluscs employed as the basis of the work were somewhat unfortunately chosen, while the Tunicates and Bryozoa (moss-polypes) are too closely associated with the Mollusca, but though some of the conclusions reached would not now be accepted, the memoir will always remain as a brilliant piece of speculative investigation, far in advance of the time when it was written. The importance attached to embryological evidence in the determination of affinities marks the influence of the veteran embryologist, Von Baer.

As an outcome of his researches on Medusæ, the Royal Society now awarded the Royal Medal for Physiology to Huxley (Nov. 30, 1852), thus still further emphasizing the high position he had already secured in the scientific world. He and the other medallists were entertained at the anniversary dinner of the Society held on the same day, and he then spoke in moderate though unmistakable terms of the delayed grant to which allusion has already been made. The way in which this speech was received clearly shows that the leading exponents of science fully sympathized with him in his position as regards the Admiralty, a sympathy indeed of which there had already been abundant proof.

The year 1852 also marks the commencement of Huxley's career as a lecturer, for on April 30 he delivered a discourse on "Animal Individuality" at the Royal Institution (Proc. Roy. Inst., i, 1851-4, pp. 184-9. Sci. Mem., i, xvi, p. 146). Remembering the popularity to

which he afterwards attained in this particular direction, it is interesting, though scarcely surprising to learn that his earlier efforts were not an unqualified success, owing to undue speed and the assumption of a conversational style. On this subject he remarks as follows in his *Autobiography* (Coll. Essays, i, p. 15):—

“At that time I disliked public speaking, and had a firm conviction that I should break down every time I opened my mouth. I believe I had every fault a speaker could have (except talking at random or indulging in rhetoric), when I spoke to the first important audience I ever addressed, on a Friday evening at the Royal Institution, in 1852. Yet, I must confess to having been guilty, *malgré moi*, of as much public speaking as most of my contemporaries, and for the last ten years it ceased to be so much of a bugbear to me. I used to pity myself for having to go through this training, but I am now more disposed to compassionate the unfortunate audiences, especially my ever-friendly hearers at the Royal Institution, who were the subjects of my oratorical experiments.”

The following two papers were published in 1853:—

1. “Observations on the Existence of Cellulose in the Tunic of Ascidiæ” (*Q. J. Micros. Sci.*, i, 1853. *Sci. Mem.*, i, XXI, p. 221.)—This is an extension of his previous work on the subject.

2. “On the Development of the Teeth, and on the Nature and Import of Nasmyth’s ‘Persistent Capsule’” (*op. cit.*, i, 1853. *Sci. Mem.*, i, XXII, p. 224.)—In this paper Huxley, after describing the development of teeth, homologizes them with hairs, a view which is not now accepted.

To these memoirs must be added a luminous exposition of “The Cell Theory” (*Brit. and For. Medico-Chir. Review*, xii, 1853, pp. 285-314. *Sci. Mem.*, i, XXIII, p. 242), which expounds the minute structure of

organisms, and of which Sir Michael Foster justly states that it was,—

“a paper which more than one young physiologist at the time read with delight, and which even to-day may be studied with no little profit,” and that “he, in this subject, as in others, drove the sword of rational inquiry through the heart of conceptions, metaphysical and transcendental, but dominant.” (Obituary Notice, Proc. Roy. Soc., lix, 1895-6, p. lv).

The Friday Evening Discourse “On the Identity of Structure of Plants and Animals,” delivered to the Royal Institution, April 15, 1853, is practically a lecture on the same theme (Proc. Roy. Inst., i, 1851-4, pp. 298-302; and Edinburgh New Philos. J., liii, 1852, pp. 172-7. Sci. Mem., i, xx, p. 216).

During these years of stress Huxley not only established his reputation as a scientific investigator, and commenced his career as a lecturer, but also laid the foundation of that literary style which ultimately gave him a prominent position in the world of letters. To the *Westminster Review* he regularly contributed the article on “Contemporary Science,” was commissioned to write a *Manual on Comparative Anatomy* for Messrs. Churchill, and so on. He estimated in fact that by means of his pen alone he was in the position to earn about £250 per annum, more than his Navy pay, and was therefore able to regard the decision of the Admiralty with comparative equanimity, and prepared, if necessary, to wait in the hope that some congenial scientific post might fall to his lot.

Just as Huxley's inimitable powers as a lecturer were very largely the result of the most painstaking cultivation, so also with his literary style. Comparatively few were privileged to hear him speak, but his writings have been and will remain a source of pleasure as well as

profit to countless thousands. Yet the eminently lucid easy style so many have admired was the result of laborious work and much re-writing, a concrete instance of that "ars celare artem" which has distinguished many masters of English prose. And his standard became ever higher as time went on. To quote the words of a well-known orator and man of letters, "in these days even a man of science is expected to be a good speaker and writer," an expectation largely due to Huxley's example, the outcome of his dictum that "science and literature are not two things, but two sides of the same thing." This salutary attitude has done no little for science, and something for literature.

When, in 1891, de Varigny was engaged in translating some of Huxley's works he received a letter containing this passage :—

"The fact is that I have a great love and respect for my native tongue, and take great pains to use it properly. Sometimes I write essays half-a-dozen times before I can get them into the proper shape; and I believe I become more fastidious as I grow older" (Life, ii, p. 291).

It is a matter of common knowledge that these strivings after a proper use of the mother tongue were successful in no mean degree.

CHAPTER IV

BEGINNING OF PROFESSORIAL WORK IN LONDON

[1854-8].

THE year 1854 was a memorable one in many ways for Huxley. His friend Edward Forbes was appointed to an Edinburgh chair, and he succeeded him in London as Lecturer in Natural History in the Royal School of Mines with a stipend of £200 per annum, and later in the year became Naturalist to the Geological Survey at a commencing salary of like amount. He was also appointed Lecturer in Comparative Anatomy at St. Thomas's Hospital. Huxley always held very strongly that London was the best centre for scientific purposes, and proved true to his convictions by spending the rest of his working life there, though he might, to his financial benefit, have become a professor in Edinburgh University. The death of Forbes later in the year was a heavy blow to him, and, by organizing a memorial fund, he helped to perpetuate the memory of one who had been his warmest and most loyal friend among the senior naturalists of that time.

By a singularly ironical stroke of fate, the Government grant which the Royal Society, for technical reasons, felt unable to award while he was still in the service of the Navy was now given him. The sum assigned was £300, and the Ray Society undertook to defray any further expense, and to publish the detailed investigations for which this grant was needed. The much-delayed monograph was not published, however,

till 1858, under the name of "The Oceanic Hydrozoa: a Description of the Calycophoridae and Physophoridae observed during the Voyage of H.M.S. *Rattlesnake*, in the years 1846-1850." To this classical work, which gives a detailed and comparative treatment of a difficult and then little-known group, and which is dedicated to Sir John Richardson, M.D., F.R.S., his old chief at Haslar, Huxley wrote a Preface, summarizing the difficulties that had prevented earlier publication, and acknowledging his indebtedness to MacLeay of Sydney, Edward Forbes, and others.

The following "Extract from a Memorandum by the Lords Commissioners of the Admiralty prefixed to the first edition of the 'Manual of Scientific Enquiry prepared for the use of Her Majesty's Navy,' edited by Sir J. F. W. Herschel, and published in 1849" is placed at the head of the Preface:—

"It is the opinion of the Lords Commissioners of the Admiralty that it would be to the honour and advantage of the Navy and conduce to the general interests of Science, if new facilities and encouragement were given to the collection of information upon scientific subjects by the officers, and more particularly by the medical officers, of Her Majesty's Navy, when upon foreign service. . . . And it will be for their Lordships to consider whether some pecuniary reward or promotion may not be given to those who succeed in producing eminently useful results."

And from the Preface itself the following extracts are worth quoting:—

"The facts are these. I made a good many observations during our cruise, and sent home several papers to the Linnean and Royal Societies; but of these doves, or rather ravens, which left my ark, I had heard absolutely nothing up to the time of my return; and, save for the always kind and hearty encouragement of the celebrated William MacLeay, whenever

our return to Sydney took me within reach of his hospitality, I know not whether I should have had the courage to continue labours which might, so far as I knew, be valueless.

“On reaching England, however, I found not only that the Royal Society had thought my Memoir on the *Medusæ* worthy of publication, but helping hands were stretched out to me on all sides; and among the men of science, I met with many generous friends whose sympathy and appreciation were bestowed in a measure, far beyond my deserts. Among these, the genial, and noble-minded Edward Forbes supported me with all that energy which he was wont to throw into his advocacy of the cause of a young man; and now that I have succeeded (though, alas! not replaced) him in the professorial chair he then held, and have some personal experience of an analogous variety of occupations and weight of responsibilities, I cannot reflect without emotion on the patient attention which he bestowed upon me, and the self-sacrificing zeal with which he exerted all his ‘power, amity, and authority’ in my favour.”

After narrating the unsuccessful attempts of his friends and himself to obtain the grant which the Admiralty minute seemed to warrant, he continues:—

“It would be wearisome were I to narrate the history of their other efforts at length. In vain the Presidents of the Royal Society and of the British Association, separately and conjointly, officially and unofficially, solicited the Treasury; in vain did I visit and write to, and I fear, bore, numerous persons in authority about this unfortunate grant. It must be confessed the business was troublesome enough while it lasted; but, in looking back, I would fain only remember with gratitude the zeal of the friends who aided me, and the long-suffering courtesy of the various Government officials, who listened so attentively to the claims of that Natural Science about which, unless I am greatly mistaken, they neither knew nor cared very much.

“During the three years the contest lasted, I reckon that the Admiralty was good enough to give me, in the form of pay, rather more than fifty pounds over the sum required, although, with steady consistency, their Lordships from the first refused to enable me to publish the work which they paid me for publishing. I by no means quarrel with an arrangement, which,

although very annoying at the time, has been of the utmost service to me; for when, in 1854, their Lordships, as I suppose, weary of our pertinacity, cut the knot by calling upon me to serve afloat, new prospects had presented themselves, and, in giving up my commission, I obtained the long-sought funds for publication—the administrators of the Government Grant no longer objecting, that the Admiralty was pledged to supply its officers with funds for the publication of work done in its service.”

The year 1854 not only brought Huxley some of the more solid rewards of success, but was satisfactory in another way, for, before his appointments fell to him, Mr. Heathorn had decided to come with his wife and daughter to England, there to reside permanently. And there was therefore an immediate prospect of marriage, after a long engagement, extending over a period of much anxiety and adversity.

The scientific work published during this year includes the following:—

I. “On the Vascular System of the Lower Annulosa” (Brit. Assoc. Rep., 1854, p. 109. Sci. Mem., i, xxiv, p. 279).—This highly speculative paper did good service by throwing doubt upon the then accepted view that certain sets of branching tubes in various worm-like forms and Echinoderms were equivalent to the blood system of higher Invertebrates. But at the same time, other homologies were suggested which subsequent research has shown to be untenable. To criticize the early pioneer work of an eminent investigator is a particularly difficult task, but here and elsewhere Huxley was rather prone to jump at conclusions, an inherited character, regarding which he himself says, “. . . it has often stood me in good stead; it has sometimes played me sad tricks, and it has always been a danger” (Autobiography, Coll. Essays, i, p. 4).

2. "On the Common Plan of Animal Forms" (Abstract of a Friday Evening Discourse delivered at the Royal Institution on May 12, 1854. Proc. Roy. Inst., i, 1851-4, pp. 444-6. Sci. Mem., i, xxv, p. 281).—After demonstrating that Vertebrates, Annulosa, and Molluscs present variations on three common plans of structure (the same being also true for other great groups), the question is raised as to the nature of the relations, if any, between such plans, the conclusion being that they are specializations of a more fundamental type, as indicated by the facts of embryology. Written in pre-Darwinian days the discourse is distinguished by what we should now call an evolutionary tone, implied rather than expressed.

3. "On the Structure and Relation of the Corpuscula Tactus (Tactile Corpuscles or Axile Corpuscles) and of the Pacinian Bodies" (Q. J. Micros. Soc., ii, 1854, pp. 1-7. Sci. Mem., i, xxvi, p. 284).

4. "On the Ultimate Structure and Relations of the Malpighian Bodies of the Spleen and of the Tonsillar Follicles" (op. cit., ii, 1854, pp. 74-82. Sci. Mem., i, xxvii, p. 291).—This and the preceding memoir are chiefly interesting as illustrating the author's leaning towards the physiological aspect of natural history (*cf.* p. 4).

An address delivered at St. Martin's Hall, July 22, 1854, "On the Educational Value of the Natural History Sciences" (Coll. Essays, iii, p. 38), marks the beginning of one important side of Huxley's life-work, *i.e.*, his persistent endeavour to secure a fitting place for science in education. In these later days, when our educational systems and ideals are undergoing revision, the claims of science are not likely to be forgotten, thanks very largely to the strenuous pioneer efforts of Huxley and men of his stamp.

In his *Preface* (dated September 4, 1893) to the volume of *Collected Essays*, in which this particular one is included, the author says :—

“The oldest piece, that ‘On the Educational Value of the Natural History Sciences,’ contains some crudities, which I repudiated when the lecture was first reprinted, more than twenty years ago ; but it will be seen that much of what I have had to say, later on in life, is merely a development of the propositions enunciated in this early and sadly-imperfect piece of work.”

Imperfect or not, the essay, which includes a luminous exposition of the scientific method, contains some fine passages, of which perhaps the most famous is one which shows the influence of Hume :—

“So far as I can arrive at any clear comprehension of the matter, science is not, as many would seem to suppose, a modification of the black art, suited to the tastes of the nineteenth century, and flourishing mainly in consequence of the decay of the Inquisition. Science is, I believe, nothing but *trained and organised common sense*, differing from the latter only as a veteran may differ from a raw recruit. . . .”

And the summing-up paragraph is well deserving the most serious attention on the part of modern educationists :—

“Biology needs no apologist when she demands a place—and a prominent place—in any scheme of education worthy of the name. Leave out the physiological sciences from your curriculum, and you launch the student into the world, undisciplined in that science whose subject-matter would best develop his powers of observation ; ignorant of facts of the deepest importance for his own and others’ welfare ; blind to the richest sources of beauty in God’s creation ; and unprovided with that belief in a living law, and an order manifesting itself in and through endless change and variety, which might serve to check and moderate that phase of despair through which, if he take an earnest interest in social problems, he will assuredly sooner or later pass.”

The Heathorns arrived in England in May 1855, and though unfortunately Miss Heathorn's feeble health gave cause for great anxiety, her marriage took place on the following July 21, the summer being spent in Tenby. Even during the honeymoon Huxley busied himself with observations on a submerged forest at Amroth, and with other scientific work. At that time Darwin seems scarcely to have realized his pre-eminently strenuous nature, for he wrote, "I hope your marriage will not make you idle; happiness, I fear, is not good for work." A warning of opposite kind would have been much more to the point.

Huxley's method of preparing lectures affords a good illustration of his indefatigable industry, in response to the prompting of a high ideal. Not content merely with acquainting himself with the relative literature, nor satisfied with his own unusually extensive knowledge, he took a vast amount of pains to acquire a first-hand acquaintance with facts from one end of the animal kingdom to the other. His lectures, in short, often involved a considerable amount of original investigation.

The following scientific memoirs require mention here:—

1. "Contributions to the Anatomy of the Brachiopoda" (Proc. Roy. Soc., vii, 1854-5, pp. 106-17, 241-2. Sci. Mem., i, xxxii, p. 325).—The ancient group of "lampshells," of which the members possess a bivalve shell that suggests a relationship to molluscs, is still one that presents many problems for solution, and naturally presented still more in the early fifties. The memoir embodies some very careful anatomical work, and throws doubt upon the interpretation of certain organs as "hearts," doubt that has since been fully justified, for the organs

in question are now well known to be connected with nitrogenous excretion.

2. "On a Hermaphrodite and Fissiparous Species of Tubicolar Annelidæ (Protula Dysteri)" (Edinburgh New Philos. J., i, 1855, pp. 113-29. Sci. Mem., i, xxxiii, p. 337).—This is a careful study of a marine worm, presenting many points of interest to the specialist.

3. "On the Structure of Noctiluca miliaris" (Q. J. Micros. Soc., iii, 1855, pp. 49-54. Sci. Mem., i, xxxiv, p. 351).—We have here a contribution to our knowledge of an animalcule which is one of the causes of the phosphorescence of the sea.

4. "On the Enamel and Dentine of the Teeth" (op. cit., iii, 1855, pp. 127-30. Sci. Mem., i, xxxv, p. 357).—This is simply an answer to criticisms by M. Edouard Lent on a previous paper.

5. "Tegumentary Organs" (in Todd's Cyclopædia of Anatomy and Physiology, published in the parts which appeared between August 1855, and October 1856. Sci. Mem., i, xxxviii, p. 365).—This classical comparative study of the skin of animals marks, as Sir Michael Foster has pointed out, that leaning to the physiological side which circumstances prevented from having full play, and which can be traced to the influence of Johannes Müller. That influence, however, and the equally potent one of Von Baer, the father of embryology, deeply tinged a very large part if not the whole of Huxley's scientific work.

6. "On Certain Zoological Arguments commonly Adduced in Favour of the Hypothesis of the Progressive Development of Animal Life in Time" (Abstract of a Friday Evening Discourse delivered at the Royal Institution, April 20, 1855; Proc. Roy. Inst., ii, 1854-8, pp. 82-5. Sci. Mem., i, xxviii, p. 300).—The lecture

combats the general view that "the history of life as a whole, in the past, is analogous to the history of each individual life in the present," and affirms that "the progress of a higher animal in development is not through the forms of the lower, but through forms which are common to both lower and higher. . . ." We find, in fact, that this pre-Darwinian discourse fully appreciates the nature of what is now known as Von Baer's Law, the subject of much misapprehension down to quite recent times. And further one of the difficulties of the evolution theory is here anticipated, *i.e.*, that the great subdivisions of the animal kingdom are of vast antiquity, and were most or all specialized in times regarding which the geological record as yet is silent, so far as life is concerned.

During the year 1855 Huxley gave his first course of lectures to working-men at Jermyn Street, thus initiating a direction of his manifold activities which proved both valuable and extremely popular. With rare exceptions, working men only were admitted to these courses, and curious subterfuges were sometimes resorted to in order to secure the much-coveted places in the auditorium. The writer knows of one such case, where a clerk succeeded in gaining admission by representing himself as a "driver," suppressing a part of his full description as a "quill-driver." Before lecturing to this kind of audience Huxley wrote to his friend Dyster:—"I am sick of the dilettante middle-class, and mean to try what I can do with these hard-handed fellows who live among facts." And in a subsequent letter, after paying a tribute to the earnestness and attention of the audience, he goes on to say:—"I believe in the fustian, and can talk better to it than to any amount of gauze and Saxony. . . ." Certain it is that Huxley exerted

his great powers to the utmost in order to make these courses of lectures a success, and it has been considered that they were his best effort in the spoken presentment of scientific truths, an opinion which the present writer is inclined to endorse.

CHAPTER V

EARLY WORK ON FOSSILS AND BACKBONED ANIMALS. MUSEUM ARRANGEMENT [1856-8].

IN 1856, Huxley's official duties as Naturalist to the Geological Survey began to lead him away from the researches on the Invertebrates which had brought him such merited distinction. This diversion, though it ultimately led to work which was of the greatest importance in the evolution controversy, was much against his will, and he tells us in his *Autobiography* that when Sir Henry de la Beche offered him the posts of Naturalist to the Survey and Lecturer in Natural History vacated by Forbes,—

“I refused the former point-blank, and accepted the latter only provisionally, telling Sir Henry that I did not care for fossils, and that I should give up Natural History as soon as I could get a physiological post. But I held the office for thirty-one years, and a large part of my work has been palæontological” (Coll. Essays, i, p. v).

During the first sixteen years of his tenure of this office he produced no fewer than thirty-eight papers and memoirs on palæontological subjects.

His first essay of the kind, “On the Method of Palæontology” (*Annals and Mag. Nat. Hist.*, xviii, 1856, pp. 43-54. *Sci. Mem.* i, xxxix, p. 432), was particularly well received in North America, and was reprinted in 1869 by the *Smithsonian Institute*. It is in part an answer to an attack made by Dr. Falconer upon a Friday Evening

Discourse "On Natural History, as Knowledge, Discipline and Power," given at the Royal Institution, February 15, 1856 (Proc. Roy. Inst., ii, 1854-8, pp. 187-95. Sci. Mem., i, xxix, p. 305). His position briefly was that palæontology is independent of the Cuvierian principle of physiological correlation or co-adaptation of organs, and is essentially the method of agreement. Utilitarian explanations of structure are also put out of court in somewhat summary fashion, an attitude which Darwinian principles have since rendered untenable in large degree. In the discourse, for instance, we read: "Who has ever dreamed of finding an utilitarian purpose in the forms and colours of flowers . . .?" Yet every biologist now knows that Christian Konrad Sprengel gave good reasons for such a belief in his famous book, *Das Entdeckte Geheimniss der Natur im Bau und in der Befruchtung der Blumen*, published at Berlin, 1793, a book for too long entirely forgotten.

Of other scientific papers bearing date 1856, we have the following:—

1. "Observations on the Structure and Affinities of Himantopterus" (Q. J. Geol. Soc., xii, 1856, pp. 34-7. Sci. Mem., i, xl, p. 445).—The paper describes a member of an ancient extinct group which finds its nearest living allies among the king-crabs.

2. "Further Observations on the Structure of Appendicularia flabellum (Chamisso)" (Q. J. Micros. Sci., iv, 1856, pp. 181-91. Sci. Mem., i, xli, p. 449).—This is a most valuable extension of a communication read before the Royal Society in 1851 upon a remarkable type of free-swimming Ascidian (*cf.* p. 13).

3. "Note on the Reproductive Organs of the Cheilostome Polyzoa" (*op. cit.*, iv, 1856, pp. 191-2. Sci. Mem., i, xlii, p. 461).—Here we have a short contribu-

tion to our knowledge of a group that had already engaged the author's attention (*cf.* p. 20).

One piece of work to which Huxley at this time turned his attention in his capacity as Naturalist to the Geological Survey was that of museum arrangement. He re-organized the Museum of Practical Geology in Jermyn Street for teaching purposes, and from this period on took a great interest in various British collections of objects, whether public or private, large or small. In his opinion, a great central collection ought to be of a triple character, providing for the general public, the specialist, and the requirements of applied science. In many respects the magnificent Natural History Museum at South Kensington, as now arranged, realizes these ideals. The Natural History Museum in Hamburg may also be pointed out as largely satisfying the requirements which Huxley deemed to be of such importance. As to local collections, he was strongly of opinion that they should primarily be of local character. And in a letter (dated December 8, 1872), to Mr. Alfred Walker, of Colwyn Bay, after emphasizing the importance of strictly local collections, he adds, very characteristically:—“Whereas the ordinary lumber-room of clubs from New Zealand, Hindoo idols, sharks' teeth, scorpions, mangy monkeys, and conch shells—who shall describe the weary inutility of it?” (*Life*, i, p. 136).

The most important personal event during 1857 was the birth, on New Year's Day, of his first child, a son, whose death nearly four years later was perhaps the greatest grief of his life, borne with that fortitude and resignation which distinguished him in times of adversity.

Unfortunately during this year, and at but too frequent intervals during the rest of his life, Huxley suffered from severe attacks of bad health, for which the best cure

proved to be walking tours in Britain or Switzerland. Considering that he was never robust, and taxed his strength to the utmost by all sorts of work, it is marvellous that he should have accomplished so much, especially when it is remembered that the last ten years of his life (sixty to seventy) were perforce comparatively unproductive, so far as pure science is concerned.

One result of summer holidays spent in Switzerland with Tyndall during this and the previous year were papers entitled, "Observations on the Structure of Glacier Ice" (*Phil. Mag.*, xiv, 1857, pp. 241-60. *Sci. Mem.* i, XLVI, p. 482), and "On the Structure and Motion of Glaciers" (*Phil. Trans. Roy. Soc.*, cxlvii, 1857, pp. 327-46. Read January 15, 1857. *Sci. Mem.* ii, I, p. 1).

Not content with giving his ordinary lectures in Jermyn Street, which many of his students were incapable of fully appreciating owing to want of acquaintance with fundamental principles, Huxley began in 1857 to give a preliminary evening course of nine lectures, with the object of supplying the general knowledge necessary. These lectures consisted of "physiography," together with the preliminaries of palæontology, and a broad sketch of the classification, distribution, and morphology of organisms.

His manifold activities now also included the duties involved by his position as Examiner in Physiology and Comparative Anatomy to the University of London.

A Friday Evening Discourse at the Royal Institution was given (May 15) "On the Present State of our Knowledge as to the Structure and Functions of Nerve" (*Proc. Roy. Inst.*, ii, 1854-8, pp. 432-7. *Sci. Mem.* i, xxx, p. 315).—In this lecture we have a further indication of strong physiological tendencies.

In this year too he was elected an honorary member of the Microscopical Society of Giessen and the Academy

of Breslau, the commencement of that general recognition of his scientific eminence by foreign countries which was afterwards manifested in so large a measure.

The scientific work for 1857 includes the following memoirs :—

1. "Description of a New Crustacean (*Pygocephalus Cooperi*, *Huxley*) from the Coal Measures" (*Q. J. Geol. Soc.*, xiii, 1857, pp. 363-9. *Sci. Mem.*, i, XLIII, p. 463).

2. "On *Dysteria*; a New Genus of Infusoria" (*Q. J. Micros. Sci.*, v, 1857, pp. 78-82. *Sci. Mem.*, i, XLIV, p. 471).—This is an account of a marine animalcule, discovered by Dr. Dyster at Tenby.

3. "Review of Dr. Hannover's Memoir: 'Ueber die Entwicklung und den Bau des Säugethierzahns'" (*op. cit.*, v, 1857, pp. 166-71. *Sci. Mem.*, i, XLV, p. 476).—This is a critical review of a research on the structure and especially on the development of mammalian teeth.

4. "On the Agamic Reproduction and Morphology of *Aphis*" (*Trans. Linn. Soc.*, xxii, 1858, pp. 193-220, 221-36. Read November 5, 1857. *Sci. Mem.*, ii, II, p. 26).—This classical memoir deals in detail with the structure and life-histories of Aphides (*vide infra*). Apart from the descriptive work it embodies generalizations of high value, and the influence of Von Baer is clearly traceable in the emphasis laid upon embryological evidence.

During 1858 the usual lectures were given, including a course on the "Principles of Biology" at the Royal Institution, the last of a triennial series delivered in the capacity of Fullerian Professor. A Friday Evening Discourse "On the Phenomena of Gemmation" was delivered at this Institution on May 21. This dealt with the extraordinary life-histories of Aphides, familiarly known as "plant lice" or "green fly," in which sexual

and asexual modes of generation alternate (*cf.* No. 4, p. 38). (Proc. Roy. Inst., ii, 1854-8, pp. 534-8. Sci. Mem., i, xxxi, p. 321).

A particularly interesting feature of the year was the organization of a scientific column in the *Saturday Review*, the outcome of a conference between Huxley, Hooker and Tyndall, who were impressed with the desirability of making recent scientific work known to the general public as well as to specialists. The column was intended to serve the purpose of a "Scientific Review," the launching of which appeared at the time to be impracticable. Some years later (1861) the original project was to some extent realized by the publication of a quarterly *Natural History Review*, which became extinct in 1865. Mr. (now Sir Norman) Lockyer was the science editor of this publication, and the experience then gained enabled him in 1869 to initiate *Nature*, which flourishes to this day.

During this year Huxley became a Fellow of the Linnean Society, and was elected a member of the Athenæum Club under the "Distinguished Persons Rule." His proposer for the latter was Sir R. J. Murchison: eighteen out of nineteen voted for the proposition, and no one against it.

Much of the scientific work for 1858 is embodied in the following memoirs:—

1. "On Cephalaspis and Pteraspis" (Q. J. Geol. Soc., xiv, 1858, pp. 267-80. Sci. Mem., i, XLVII, p. 502).—The structure of these extraordinary fossil forms, which we now know to be of lower grade than fishes, is carefully discussed, and their possible affinities with certain members of the group of ordinary bony fishes are pointed out.

2. "Observations on the Genus Pteraspis" (Brit. Assoc. Rep., 1858, Part 2, pp. 82-3. Sci. Mem., i,

XLVIII, p. 517). The suggestions made by the author in the last memoir as to the affinities of these extinct types is repeated with rather more emphasis, on the strength of further evidence. The view tentatively advanced would not now be accepted, but the difficulty of the matter is fully realized, and there is a marked absence of dogmatic statement.

3. "On a New Species of Plesiosaurus, etc." (Q. J. Geol. Soc., xiv, 1858, pp. 281-94. Sci. Mem., i, XLIX, p. 522).—This technical comparative memoir is an important contribution to our knowledge of a remarkable group of swan-necked marine reptiles which were dominant during the Mesozoic epoch.

4. "On Some Points in the Anatomy of Nautilus pompilius" (J. Linn. Soc. (Zool.), iii, 1859, pp. 36-44. Read June 3, 1858. Sci. Mem., ii, III, p. 81).—This is an addition to our knowledge of the pearly Nautilus, the last survivor of a long series of extinct types.

5. "On the Theory of the Vertebrate Skull" (Proc. Roy. Soc., ix, 1857-9, pp. 381-457; Annals and Mag. Nat. Hist., iii, 1859, pp. 414-39. Sci. Mem., i, L, p. 538).—Here we have an epoch-making memoir, which is in substance the Croonian lecture delivered before the Royal Society, June 17, 1858. It completely demolishes the transcendental theory of Oken that the skull is in reality composed of three modified vertebrae, and is therefore equivalent to a modified piece of the backbone. The facts of comparative anatomy and embryology are marshalled in a masterly fashion against this conception. At the same time the speculative views of Owen, founded upon those of Oken, are subjected to destructive criticism.

This precluded any settlement of the rupture which had taken place the previous year between the two

specialists, the outcome of gradually increasing tension, for which Huxley was in nowise to blame. The importance of the memoir was long after summarized by Sir Michael Foster in his Obituary Notice of the author :—

“ This lecture marked an epoch in England in vertebrate morphology, and the views enunciated in it carried forward, if somewhat modified, as they have been, not only by Huxley’s subsequent researches, and by those of his disciples, but especially by the splendid work of Gegenbaur, are still, in the main, the views of the anatomists of to-day ” (Proc. Roy. Soc., lix, 1895-6, p. liv).

CHAPTER VI

THE ORIGIN OF SPECIES [1859].

THERE are three classical works, published at intervals of fifty years, which have exercised a far-reaching influence upon the progress of science and the development of thought in general. The first of these was Caspar Friedrich Wolff's *Theoria Generationis* (1759), in which the progressive development of the individual by gradual upbuilding (epigenesis) from a simple germ is maintained as against the rival theory (then called "evolution") asserting that this development consists merely in an expansion of parts present from the first.

Fifty years later (1809) Lamarck published his *Philosophie Zoologique*, in which the progressive development of species ("evolution" in the modern sense) is deduced from various classes of facts, and ascribed to the direct influence of surroundings (environment), of crossing, and of habits (use and disuse).

After the lapse of still another half-century *The Origin of Species by Means of Natural Selection*, by Charles Darwin, made its appearance on November 24, 1859, being preceded (July, 1858) by joint communications to the Linnean Society made by the author and Alfred Russel Wallace, who had independently arrived at similar conclusions. The theory of Natural Selection is founded upon three classes of facts, *i.e.*, the keen "struggle for existence" that undoubtedly takes place in nature as the result of rapid increase, the differences between members of the same species (variation), and

the transmission of characters from one generation to another (heredity). Individuals varying in directions giving them an advantage in the struggle for existence are more likely to survive and leave offspring than their fellows, *i.e.*, have a better chance of being “naturally selected.” And the inheritance of such characters, increased in amount by further variation, may be supposed in the end to lead to sufficient divergence from the original stock to constitute new species, just as the “breeds” of domesticated animals have been brought into existence by “artificial selection.”

Until Darwin’s work appeared Huxley neither affirmed nor denied the possibility of transmutation of species, and his scientific work on the lines laid down by Johannes Müller and Von Baer kept him more than occupied, without troubling unduly about the matter. Even the influence of Herbert Spencer, who held evolution to be a logical necessity, had failed to make him adopt positive evolutionary views. Writing long afterwards on this point he says :—

“I took my stand upon two grounds :—Firstly, that up to that time, the evidence in favour of transmutation was wholly insufficient ; and secondly, that no suggestion respecting the causes of transmutation assumed, which had been made, was in any way adequate to explain the phenomena. Looking back at the state of knowledge at that time, I really do not see that any other conclusion was justifiable” (Darwin’s Life and Letters, ii. p. 188).

In the same place Huxley tells us that the influence of Lyell,

“was perhaps more potent than any other in keeping alive a sort of pious conviction that evolution, after all, would turn out true. I have recently read afresh the first edition of the *Principles of Geology* ; and when I consider that this remarkable

book had been nearly thirty years in everybody's hands, and that it brings home to any reader of ordinary intelligence a great principle and a great fact,—the principle that the past must be explained by the present, unless good cause be shown to the contrary; and the fact that so far as our knowledge of the past history of life on our globe goes, no such cause can be shown,—I cannot but believe that Lyell, for others, as for myself, was the chief agent in smoothing the road for Darwin. For consistent uniformitarianism postulates Evolution as much in the organic as in the inorganic world. The origin of a new species by other than ordinary agencies would be a vastly greater 'catastrophe' than any of those which Lyell successfully eliminated from sober geological speculation" (pp. 189-90).

Darwin attached great importance to the opinions of Lyell, Hooker and Huxley as regards his theory. After making a deep impression upon Lyell (who afterwards proclaimed himself a Darwinian, though with important reservations), and completely converting Hooker, he writes: "If I can convert Huxley I shall be content" (Darwin's Life, ii, p. 221). And he subsequently had good cause for more than usual contentment, as Huxley's vigorous championship of the new views, when these were ignorantly or fanatically attacked, brought them into great prominence and compelled that careful attention on the part of competent authorities without which their progress might have been indefinitely delayed.

Huxley, however, was no unreasoning partizan, and, while accepting the Darwinian theory as a good working hypothesis, realized the difficulties involved and made no secret of them. In the Preface (dated April 7, 1893) to the second volume of his *Collected Essays*, he remarks:—

"Those who take the trouble to read the first two essays (*i.e.* 'The Darwinian Hypothesis,' and 'The Origin of Species') published in 1859 and 1860, will, I think, do me the justice to admit that my zeal to secure fair-play for Mr.

Darwin did not drive me into the position of a mere advocate ; and that, while doing justice to the greatness of the argument, I did not fail to indicate its weak points. I have never seen any reason for departing from the position which I took up in these two essays ; and the assertion which I sometimes meet with nowadays, that I have ‘ recanted ’ or changed my opinions about Mr. Darwin’s views, is quite unintelligible to me.”

A lecture “ On the Persistent Types of Animal Life ” (Proc. Roy. Inst., iii, 1858-62, pp. 151-3. Sci. Mem., ii, iv, p. 90), delivered at the Royal Institution on June 3, of this year, and in part the outcome of his work on *Nautilus* (one such type), anticipates one of the objections afterwards brought against Darwinism, *i.e.*, that it is not justified by the evidence of geology. The lecture points out that such persistence is only explicable on evolutionary grounds, and also lays stress on the imperfection of the geological record.

When, later in the year, the *Origin* made its appearance, Huxley, by a singular piece of good fortune, was entrusted with the review for the *Times*.

This was written in Huxley’s best style, and the inspiration of the subject enabled him to complete it with great rapidity, in strong contrast to his usual practice. In it he says :—

“ That this most ingenious hypothesis enables us to give a reason for many apparent anomalies in the distribution of living beings in space and time, and that it is not contradicted by the main phenomena of life and organization appear to us to be unquestionable.”

But readers of the book are enjoined, in characteristic fashion, to maintain that spirit of—

“doubt, which so loves truth, that it neither dares rest in doubting, nor extinguish itself by unjustified belief.”

And finally :—

“Mr. Darwin abhors mere speculation as nature abhors a vacuum. He is as greedy of cases and precedents as any constitutional lawyer, and all the principles he lays down are capable of being brought to the test of observation and experiment. The path he bids us follow professes to be not a mere airy track, fabricated of ideal cobwebs, but a solid and broad bridge of facts. If it be so, it will carry us safely over many a chasm in our knowledge, and lead us to a region free from the snares of those fascinating but barren virgins, the Final Causes, against whom a high authority has so justly warned us” (Coll. Essays, ii, p. 1).

This year he was appointed Secretary to the Geological Society, a new kind of activity in which he rendered eminent service till 1885, when he resigned his Presidency of the Royal Society. During the summer he also took part in a movement initiated by Dr. Carpenter, to which in part may be traced the origin of the marine biological stations that now play such an important rôle in science. For he spent some time trawling off Arran, where Carpenter some years before had found suitable head-quarters in a cottage on Holy Island (in Lamlash Bay), and in the following winter carried out investigations on the spawning of herrings in the neighbourhood of Bute, this being the commencement of his fishery work. At Huxley's request, Sir Roderick Murchison, then head of the Geological Survey, consented to subsidize this pioneer scheme for a term of years.

Mention must also be made of the fact that Tyndall was at this time appointed Professor of Physics in the Royal School of Mines, a post which he retained till 1868, and this intimate association meant much to Huxley in a variety of ways, and cemented what was already a friendship of no common order. One aspect

of this is thus amusingly given in a letter to Hooker of the previous year :—

“Why I value your and Tyndall’s and Darwin’s friendship so much is, among other things, that you all pitch into me when necessary. You may depend upon it, however blue I may look when in the wrong, it’s wrath with myself and nobody else” (Life, i, p. 157).

The scientific memoirs of the year, chiefly palæontological, are as follows :—

1. “On the *Stagonolepis Robertsoni* (Agassiz) of the Elgin Sandstones; and on the Recently Discovered Footmarks in the Sandstones of Cumingstone” (Q. J. Geol. Soc., xv, 1859, pp. 440-60. Sci. Mem., ii, v, p. 94).—The remains of a supposed fossil fish are here proved to be in reality those of a crocodilian reptile.

2. “On some Amphibian and Reptilian Remains from South Africa and Australia” (op. cit., xv, 1859, pp. 642-9. Read March 3, 1859. Sci. Mem., ii, vi, p. 120).

3. “On a New Species of *Dicynodon* (*D. Murrayi*), from near Colesberg, South Africa; and on the Structure of the Skull in the *Dicynodonts*” (op. cit., xv, 1859, pp. 649-58. Read March 23, 1859. Sci. Mem., ii, vii, p. 130).—The reptile in question belongs to an extraordinary extinct group, among which the species of *Dicynodon* possess only two teeth, these being in the form of tusks projecting from the upper jaw.

4. “On *Rhamphorhynchus Bucklandi*, a Pterosaurian from the Stonefield Slate” (op. cit., xv, 1859, pp. 658-70. Read March 23, 1859. Sci. Mem., ii, viii, p. 141).—This deals with one of the extinct flying reptiles.

5. “On a Fossil Bird and a Fossil Cetacean from New Zealand” (op. cit., xv, 1859, pp. 670-7. Read

March 23, 1859. *Sci. Mem.*, ii, ix, p. 157).—Two bones, belonging respectively to a large species of penguin and a porpoise-like Cetacean are described in this paper.

6. "On the Dermal Armour of *Crocodilus Hastingsiæ*" (*op. cit.*, xv, 1859, pp. 678-80. Read March 23, 1859. *Sci. Mem.*, ii, x, p. 166).—Here an account is given of the bony scutes belonging to an extinct crocodile.

7. "On the Anatomy and Affinities of the Genus *Pterygotus*" (*Mems. Geol. Survey U.K., Monograph I*, 1859, pp. 1-36. *Sci. Mem.*, ii, xi, p. 170).—This important monograph describes in detail the structure of a typical genus of an ancient extinct group, perhaps most nearly represented at the present day by the king-crabs. The conclusion is reached that the group may be regarded as an order of the Crustacea, an opinion which more recent research has to some extent modified. The relation to the extinct trilobites is also pointed out.

8. "On *Dasyceps Bucklandi* (*Labyrinthodon Bucklandi, Lloyd*)" (*op. cit.*, 1859, pp. 52-6. *Sci. Mem.*, ii, xiii, p. 263).—The memoir describes the skull of one of those extinct armoured Amphibians which were dominant until their supremacy of the land was usurped by Reptiles.

9. "On a Fragment of a Lower Jaw of a Large *Labyrinthodont* from Cubbington" (*op. cit.*, 1859, pp. 56-7. *Sci. Mem.*, ii, xvi, p. 269).—This paper has reference to another Amphibian belonging to the group just mentioned.

10. "Observations on the Development of Some Parts of the Skeleton of Fishes" (*Q. J. Micros. Sci.*, vii, 1859, pp. 33-46. *Sci. Mem.*, ii, xv, p. 271).—The greater part of this particularly interesting memoir deals

with the development of the tail of a species of stickleback. It is a familiar fact that the tail of a shark or dogfish, members of a very ancient group, is externally markedly unsymmetrical, there being a large upper lobe into or towards which the vertebral column is bent. The tails of the more modern bony fishes, *e.g.*, herring, mackerel, and stickleback, are externally symmetrical, and the backbone appears to end off where its upper and lower lobes begin. A study of the development of the latter shows, however, that this kind of tail is merely an improvement of the older type, and that internally it is markedly unsymmetrical.

11. "On the Dermal Armour of Jacare and Caiman, with Notes on the Specific and Generic Characters of Recent Crocodilia" (J. Linn. Soc. (Zool.), iv, 1860, pp. 1-28. Read February 15, 1859. Sci. Mem., ii, xvi, p. 286).—The research embodied in this memoir was led up to by previous work upon extinct crocodilians.

12. "On the Anatomy and Development of Pyrosoma" (Trans. Linn. Soc., xxiii, 1862, pp. 193-250. Read December 1, 1859. Sci. Mem., ii, xvii, p. 313).—This classical monograph deals with a floating colonial tunicate or ascidian, which is one of the sources of the phosphorescence of the sea. The subject is worked out in detail, and alternation of generations established for the life-history.

CHAPTER VII

THE DEFENCE OF DARWIN [1860].

THE year 1860 was destined to prove of great importance for the progress of the new theory. During that year Huxley expounded and championed Darwin's views to audiences of two kinds, *i.e.*, to his familiar auditory at the Royal Institution, and before the British Association at Oxford.

On Friday, February 10, he delivered a Friday Evening Discourse at the Royal Institution "On Species and Races, and their Origin" (Proc. Roy. Inst., iii, 1858-62, pp. 195-200; Annals and Mag. Nat. Hist., v, 1860, pp. 344-6. Sci. Mem., ii, xviii, p. 388).—After a lucid exposition of the nature of the Darwinian hypothesis, and some of the main facts upon which it is founded, the lecture ends with an eloquent appeal for fair treatment, without any shirking of the logical consequences of such arguments as may be regarded valid :—

"Another, and unfortunately a large class of persons take fright at the logical consequences of such a doctrine as that put forth by Mr. Darwin. If all species have arisen in this way, say they—Man himself must have done so; and he and all the animated world must have had a common origin. Most assuredly. No question of it.

"But I would ask, does this logical necessity add one single difficulty of importance to those which already confront us on all sides whenever we contemplate our relations to the surrounding universe? I think not. Let man's mistaken vanity, his foolish contempt for the material world, impel him to struggle

as he will, he strives in vain to break through the ties which hold him to matter and the lower forms of life. . . .

“I have said that the man of science is the sworn interpreter of nature in the high court of reason. But of what avail is his honest speech if ignorance is the assessor of the judge, and prejudice foreman of the jury? I hardly know of a great physical truth, whose universal reception has not been preceded by an epoch in which most estimable persons have maintained that the phenomena investigated were directly dependent on the Divine Will, and that the attempt to investigate them was not only futile, but blasphemous. And there is a wonderful tenacity of life about this sort of opposition to physical science. Crushed and maimed in every battle, it yet seems never to be slain; and after a hundred defeats it is at this day as rampant, though happily not so mischievous, as in the time of Galileo.

“But to those whose life is spent, to use Newton’s noble words, in picking up here a pebble and there a pebble on the shores of the great ocean of truth—who watch, day by day, the slow but sure advance of that mighty tide, bearing on its bosom the thousand treasures wherewith man ennobles and beautifies his life—it would be laughable, if it were not so sad, to see the little Canutes of the hour enthroned in solemn state, bidding that great wave to stay, and threatening to check its beneficent progress. The wave rises and they fly; but unlike the brave old Dane, they learn no lesson of humility: the throne is pitched at what seems a safe distance, and the folly is repeated.

“Surely it is the duty of the public to discourage everything of this kind, to discredit these foolish meddlers who think they do the Almighty a service by preventing a thorough study of his works.”

And again, after alluding to the contests which the new renaissance of scientific thought was likely to involve:—

“But I verily believe that come what will, the part which England may play in the battle is a grand and a noble one. She may prove to the world that for one people, at any rate, despotism and demagoguery are not the necessary alternatives of government: that freedom and order are not incompatible; that

reverence is the handmaid of knowledge; that free discussion is the life of truth, and of true unity in a nation."

It is a somewhat curious fact that, but for the urgent request of Robert Chambers, Huxley had intended not to champion the cause of evolution in the now famous debate at the British Association in the summer, for he realized very fully the difficulties presented by a mixed audience, and the *argumentum ad hominem* that was sure to be employed on the other side. Preliminary skirmishing took place on Thursday, June 28, when, in the discussion that followed a paper by Dr. Daubeny, read before Section D, Owen stated as a fact that the gorilla's brain "presented more differences, as compared with the brain of man, than it did when compared with the brains of the lowest and most problematical of the *Quadrumana*." Huxley's special knowledge enabled him flatly to contradict so unwarranted an assertion, this "unusual procedure" being fully justified subsequently.

The historic debate took place on the following Saturday, when Wilberforce, the then Bishop of Oxford, crammed to the muzzle by Owen with undigested and inaccurate information, spoke,

"For full half an hour with inimitable spirit, emptiness and unfairness. . . . In a light, scoffing tone, florid and fluent, he assured us there was nothing in the idea of evolution; rock-pigeons were what rock-pigeons had always been. Then, turning to his antagonist with a smiling insolence, he begged to know, was it through his grandfather or his grandmother that he claimed his descent from a monkey?" (Reminiscences of a Grandmother, Macmillan's Magazine, October 1898).

Such mistaken flippancy helped the evolutionary cause in no small degree. Ignorance might be condoned, but not such an unworthy resort to the resources of mob

oratory. As Professor Farrar afterwards wrote to Mr. Leonard Huxley :—

“ His false humour was an attempt to arouse the antipathy about degrading *woman* to the quadrumana. Your father’s reply showed there was vulgarity as well as folly in the Bishop’s words, and the impression distinctly was, that the Bishop’s party, as they left the room, felt abashed, and recognised that the Bishop had forgotten to behave like a perfect gentleman ” (Life, i, pp. 183-4, footnote).

Huxley himself was the first to realize the advantage gained by the rhetorical error of the Bishop, remarking to Sir Benjamin Brodie, “ The Lord hath delivered him into mine hands.” No absolutely reliable account exists of Huxley’s reply, which after dealing with the scientific issues raised, ended with a retort that is not likely to be forgotten. Huxley himself was of opinion that the following rendering by the late John Richard Green approached most nearly to accuracy, but it is practically certain that the word “ equivocal ” was not employed :—

“ I asserted—and I repeat—that a man has no reason to be ashamed of having an ape for his grandfather. If there were an ancestor whom I should feel shame in recalling it would rather be a *man*—a man of restless and versatile intellect—who, not content with an equivocal success in his own sphere of activity, plunges into scientific questions with which he has no real acquaintance, only to obscure them by an aimless rhetoric, and distract the attention of his hearers from the real point at issue by eloquent digressions and skilled appeals to religious prejudice ” (Life, i, p. 185).

Hooker, from the botanical side, completed the discomfiture of the anti-evolutionary forces.

The Oxford meeting proved Huxley to be a debater of the first order, and from this time on he was justly regarded as *the* champion of Darwinian principles, and

as illustrating the love of fair-play which is characteristic of a British audience, it is worth noting that on this occasion he was applauded almost as warmly as his antagonist on the conclusion of his speech. Though the personal tone imparted to the discussion, and for which he was not responsible, was distinctly repugnant to him, it must be confessed that he was essentially a fighting man, who rejoiced in "smiting the Amalekites," to use his own expression. Without his keen support at this critical juncture it is possible that the most luminous biological theory of the last century might have been considerably retarded in its progress, much to the detriment of science and intellectual advance in general.

The vigorous essay on "The Origin of Species" (Coll. Essays, ii, p. 22), belonging to the same year, was a further important contribution to the promulgation and defence of Darwinism, of which the following well-known passages will always be quoted:—

"In this nineteenth century, as at the dawn of modern physical science, the cosmogony of the semi-barbarous Hebrew is the incubus of the philosopher and the opprobrium of the orthodox. . . . It is true that if philosophers have suffered, their cause has been amply revenged. Extinguished theologians lie about the cradle of every science as the strangled snakes about that of Hercules; and history records that whenever science and orthodoxy have been fairly opposed, the latter has been forced to retire from the lists, bleeding and crushed, if not annihilated; scotched, if not slain."

And, after alluding to the recurrence of untenable idea:—

"Philosophers, on the other hand, have no such aggressive tendencies. With eyes fixed on the noble goal to which 'per aspera et ardua' they tend, they may, now and then, be stirred to momentary wrath by the unnecessary obstacles with which the ignorant or the malicious encumber, if they cannot bar, the

difficult path ; but why should their souls be deeply vexed ? The majesty of fact is on their side, and the elemental forces of Nature are working for them. . . . Harmonious order governing eternally continuous progress—the web and woof of matter and force interweaving by slow degrees, without a broken thread, that veil which lies between us and the Infinite—that universe which alone we know or can know ; such is the picture which science draws of the world, and in proportion as any part of that picture is in unison with the rest, so may we feel sure that it is rightly painted. Shall Biology alone remain out of harmony with her sister sciences ?”

The following passages are of particular interest, being in some sort prophetic :—

“Mr Darwin’s position might, we think, have been even stronger than it is if he had not embarrassed himself with the aphorism, *Natura non facit saltum*, which turns up so often in his pages. We believe, as we have said above, that Nature does make jumps now and then, and a recognition of the fact is of no small importance in disposing of many minor objections to the doctrine of transmutation. . . . What if the orbit of Darwinism should be a little too circular ? What if species should offer residual phenomena, here and there, not explicable by natural selection ? . . . And viewed as a whole, we do not believe that, since the publication of Von Baer’s *Researches on Development*, thirty years ago, any work has appeared calculated to exert so large an influence, not only on the future of Biology, but in extending the domination of Science over regions of thought into which she has, as yet, hardly penetrated.”

The defence of Darwinism in various ways, and before diverse audiences, by no means occupied the whole of Huxley’s time, lecture work apart, during 1860. This year, for example, witnessed the completion of the arrangements for bringing out the *Natural History Review*, regarding which enough has been said elsewhere (p. 39), and the first number of which appeared in January, 1861.

Notice must also be made of a paper “On the Structure of the Mouth and Pharynx of the Scorpion” (Q. J.

Micros. Sci., viii, 1860, pp. 250-4. Sci. Mem., ii, xix, p. 395).—This cleared up some obscure points in the structure of a common type, which in most respects had already been studied with considerable thoroughness. A scorpion feeds upon the juices of its prey, in adaptation to which its mouth is shown to be exceedingly small, and to open into a gullet connected with a pharynx serving as a sort of suction-pump.

Another memoir of the year is "On a New Species of *Macrauchenia* (*M. Bolivensis*)" (Q. J. Geol. Soc., xvii, 1861, pp. 73-84. Read November 21, 1860. Sci. Mem., ii, xxi, p. 403).—The extinct type dealt with, subsequently placed in a special group, is given as an example of the necessity for caution in making deductions, for it combines cameline and equine characters.

It is further very interesting to find that Huxley rendered invaluable service to Herbert Spencer by going through the proofs of the *First Principles*, and offering valuable criticisms thereon. Similar good offices were continued for a long series of years.

The desirability of higher education for women is now so widely approved in this country, and so largely carried into practice, that Huxley's views on the subject, expressed in a letter to Sir Charles Lyell (March 17, 1860), seem imbued with the spirit of to-day. The letter primarily referred to the question of admitting women to the membership of learned societies, in which matter there is even yet a good deal of conservatism, but its interest rather lies in the broader questions touched upon. The writer expresses a strong desire that the intellectual advancement and development of women should be promoted, and expresses his intention of giving his daughters a proper training in physical science, adding the following statement of belief as to the result that might be expected

to follow the general adoption of such a plan : “ If other people would do the like, the next generation would see women fit to be the companions of men in all their pursuits—though I don’t think men have anything to fear from their competition.” The letter concludes by strongly doubting whether such an educational advance would find general favour (*Life*, i, pp. 211-12).

Unfortunately the year was not to pass without deep personal sorrow, for on September 15, Huxley’s first-born son died very suddenly from scarlet fever. The birth of a second son later in the year afforded some consolation, nor was there wanting the sympathy of as staunch friends as any man ever had.

In a long and candid letter, in answer to one received from Charles Kingsley, we find the principles of agnostic philosophy fully set forth, and a statement of entire belief in the absolute justice of Nature.

CHAPTER VIII

DISSEMINATION AND SUPPORT OF EVOLUTIONARY DOCTRINES [1861-2].

THE crushing bereavement mentioned in the last chapter increased rather than diminished the amount of work done by Huxley during the following year (1861). Partly, no doubt, because he recognized that work is the only panacea for human ills, and partly owing to his intensely energetic nature, constructed as he was "on the high-pressure tubular-boiler principle," to use his own description. Here, too, we may possibly trace the influence of Carlyle. The vigour with which fresh labours were begun and old ones continued, was partly the result of a Christmas vacation spent in mountain climbing in Snowdonia.

Darwin, Lyell and Hooker, all entered kindly remonstrances against the immense amount of work not only undertaken, but actually accomplished, and there is no doubt that their advice was fully justified, for Huxley grew old before his time, and ultimately broke down at a comparatively early age. But every man must work in his own manner, and the advancement of science was very possibly better served by concentrated efforts.

Hooker's remonstrance is of particular interest, for it expresses in some sense what many have felt :—

"Do take the counsel of a quiet looker-on and withdraw to your books and studies in pure Natural History ; let modes of thought alone. You may make a very good naturalist or a very

good metaphysician (of that I know nothing, don't despise me), but you have neither time nor place for both" (Life, i, p. 229).

There is, however, no doubt as to the "good naturalist," but regarding the rest opinion would scarcely be unanimous.

Much of the work of 1861 naturally had reference to evolution, whether by way of exposition or in the form of research lending support to Darwin's views.

In the early part of the year he lectured to workingmen on "The Relation of Man to the rest of the Animal Kingdom," a subject to which he had for some time devoted special attention, and which was naturally the central point about which the controversial war waged most bitterly. On this particular audience he obviously made a deep impression, and humorously remarks in a letter to his wife—"By next Friday evening they will all be convinced that they are monkeys" (Life, i, p. 190).

Two lectures, included in his published works, come under the pro-Darwinian utterances. One was a Friday Evening Discourse (February 8) at the Royal Institution, "On the Nature of the Earliest Stages of the Development of Animals" (Proc. Roy. Inst., iii, 1858-62, pp. 315-7. Sci. Mem., ii, xx, p. 400).—Taking the development of the free-swimming colonial ascidian *Pyrosoma* as a text (*cf.* p. 49), the early evolution of the individual is described, and shown to be a matter of gradual up-building, step by step (epigenesis), a passage from simple to complex, and not a mere increase in size (evolution in the older sense). In short, the discourse illustrates the principles of development first laid down by Caspar Friedrich Wolff (*cf.* p. 42).

The second lecture, delivered at South Kensington, was entitled, "A Lobster: or the Study of Zoology"

(Coll. Essays, viii, p. 196). The particular volume of *Collected Essays* in which this is reprinted largely consists of popular lectures, and the following extract from the Preface (dated April, 1894) shows that Huxley attached great importance to discourses of the kind, if undertaken in a proper spirit :—

“ . . . I have not been one of those fortunate persons who are able to regard a popular lecture as a mere *bors-d'œuvre*, unworthy of being ranked among the serious efforts of a philosopher ; and who keep their fame as scientific hierophants unsullied by attempts—at least of the successful sort—to be understood of the people. On the contrary, I found that the task of putting the truths learned in the field, the laboratory and the museum, into language which, without bating a jot of scientific accuracy shall be generally intelligible, taxed such scientific and literary faculty as I possess to the uttermost ; indeed my experience has furnished me with no better corrective of the tendency to scholastic pedantry which besets all those who are absorbed in pursuits remote from the common ways of men, and become habituated to think and speak in the technical dialect of their own little world, as if there were no other.”

In this lecture the anatomy and physiology of a lobster are reviewed, and used to illustrate some of the general principles of biology, after which the proper methods of teaching physical science in general and zoology in particular are laid down, and the claims of science to an important place in education vindicated. Those who are interested in the complex educational problems, the solution of which exercises us to-day, would do well to study this essay, now over forty years old.

The essence of the much debated “type-system,” with the establishment of which Huxley had so much to do, is embodied in the following sentence :—

“ The great matter is, to make teaching real and practical, by

fixing the attention of the student on particular facts; but at the same time it should be rendered broad and comprehensive, by constant reference to the generalizations of which all particular facts are illustrations."

The respective uses of lectures, demonstrations and examinations, as parts of the educational machinery, are then discussed, and the lecture concludes with a protest against existing systems of instruction, and an eloquent appeal that science be given her proper place:—

"Modern civilization rests upon physical science; take away her gifts to our own country, and our position among the leading nations of the world is gone to-morrow; for it is physical science only that makes intelligence and moral energy stronger than brute force. The whole of modern thought is steeped in science; it has made its way into the works of our best poets, and even the mere man of letters, who affects to ignore and despise science, is unconsciously impregnated with her spirit, and indebted for his best products to her methods."

In the British Association Meeting of 1860, Huxley's unrivalled anatomical knowledge had enabled him to flatly contradict the statement made by Owen that man is marked off from all other animals by the structure of his brain, a promise being at the same time made that in due course the contradiction should be fully justified. This, of course, led to renewed investigations on the subject now to be published.

The first contribution of the kind to science, "On the Zoological Relations of Man with the Lower Animals," appeared in the first number of the *Natural History Review* (1861, pp. 67-84. *Sci. Mem.*, ii, xxvi, p. 471), and in this, after discussing a number of the leading features of human anatomy, the author accepts the old Linnean view "that Man is to be regarded as a genus of

the same order as that which contains the *Quadrumana* [*i.e.*, apes and monkeys].”

A technical memoir, “On the Brain of *Ateles paniscus*” (*Proc. Zool. Soc.*, 1861, pp. 247-60. *Sci. Mem.*, ii, xxvii, p. 493), proves that certain structures asserted to be peculiar to man are present in the brain of this species of spider-monkey, a comparatively low type.

The following important palæontological memoirs also made their appearance in 1861:—

1. “On *Pteraspis Dunensis* (*Archæoteuthis Dunensis*, *Roemer*)” (*Q. J. Geol. Soc.*, xvii. 1861, pp. 163-6. Read January 23, 1861. *Sci. Mem.*, ii, xxii, p. 417).—The fossil described was shown to be the head-shield of an ancient vertebrate, and not the pen of an extinct cuttle-fish, as supposed by the first describer. The affinity with sturgeons suggested has not been justified by subsequent research, *Pteraspis* and its allies being now regarded as constituting a group lower in the scale than any known fishes.

2. “Preliminary Essay upon the Systematic Arrangement of the Fishes of the Devonian Epoch” (*Mems. Geol. Survey U.K.*, Decade X., 1861. *Sci. Mem.*, ii, xxiii, p. 421).—In this important memoir the foundations of a rational classification of extinct fishes, especially those known as Ganoids (of which sturgeons are the best-known living examples), are laid down. In the same decade two memoirs on particular extinct types of fish are included, *i.e.*:—

3. “*Glyptolæmus Kinnairdi*” (*op. cit.*, pp. 41-6. *Sci. Mem.*, ii, xxiv, p. 461); and 4. “*Phaneropleuron Andersoni*” (*op. cit.*, pp. 47-9. *Sci. Mem.*, ii, xxv, p. 467).

Huxley had already made a special study of the vertebrate skull (*cf.* p. 40), and in the course of this year con-

tinued his work in that direction, investigating cranial development in the chick. This subsequently led on to particularly valuable and epoch-making work on the classification of birds.

Examinations and continued assistance given to Spencer in the matter of proof-sheets helped to swell the enormous amount of work done during the year.

1862.

In January, 1862, two lectures were given in Edinburgh, "On the Relation of Man to the Lower Animals" (Coll. Essays, vii, p. 77).—After a preliminary sketch of development, the physical structure of man is compared with that of the apes, and the conclusion reached that there is no greater structural barrier between the two than between the higher apes and ordinary monkeys. Darwinism is then advanced as the only hypothesis as to the origin of species "which has any scientific existence." No attempt is made to slur over the provisional nature of that hypothesis, the weak points in which are fully set forth; and after denial of mere partizanship Huxley gives in brief the reasons which induced him provisionally to accept the hypothesis:—

" . . . the last position in which I wish to find myself is that of an advocate for Mr. Darwin's, or any other views; if by an advocate is meant one whose business it is to smooth over real difficulties and to persuade where he cannot convince.

"I adopt Mr. Darwin's hypothesis, therefore, subject to the production of proof that physiological species may be produced by selective breeding; just as a physical philosopher may accept the undulatory theory of light subject to the proof of the existence of the hypothetical ether; or as the chemist adopts the atomic theory, subject to the proof of the existence of atoms; and for exactly the same reasons, namely, that it has an

immense amount of *primâ facie* probability: that it is the only means at present within reach of reducing the chaos of observed facts to order; and lastly, that it is the most powerful instrument of investigation which has been presented to naturalists since the invention of the natural system of classification, and the commencement of the systematic study of embryology."

The masterly conclusion of the second lecture, which endeavours to combat the objection, "that the belief in the unity of origin of man and brutes involves the brutalization and degradation of the former," contains some fine passages, which are widely known. After the absence of an absolute physical or even psychical boundary line between man and apes is strongly insisted upon, we read:—

"At the same time, no one is more strongly convinced than I am of the vastness of the gulf between civilized man and the brutes; or is more certain that whether *from* them or not, he is assuredly not *of* them. No one is less disposed to think lightly of the present dignity, or despairingly of the future hopes, of the only consciously intelligent denizen of this world."

And again:—

"Nay more, thoughtful men, once escaped from the blinding influences of traditional prejudice, will find in the lowly stock whence Man has sprung, the best evidence of the splendour of his capacities; and will discern in his long progress through the Past, a reasonable ground of faith in his attainment of a nobler Future. . . . Our reverence for the nobility of manhood will not be lessened by the knowledge that Man is, in substance and in structure, one with the brutes; for he alone possesses the marvellous endowment of intelligible and rational speech, whereby, in the secular period of his existence, he has slowly accumulated and organised the experience which is almost wholly lost with the cessation of every individual life in other animals; so that, now, he stands raised upon it as on a mountain top, far above the level of his humble fellows, and transfigured from his grosser

nature by reflecting here and there, a ray from the infinite source of truth."

The Edinburgh audience was enthusiastic, but the publication of the reports of the lectures was followed by bitter and indeed scurrilous attacks, including such choice expressions as "foul outrage," "vilest and beastliest paradox," and "offensive, mischievous and inexcusable exhibition." Huxley answered these attacks in the *Scotsman*, sarcastically welcoming such onslaughts as affording "the best security for the dissemination of my views through regions which they might not otherwise reach."

During January of this same year (1862), he began to work at ethnology, a subject in which he afterwards attained eminence, and his interest in which was apparently first aroused during the voyage of the *Rattlesnake*. The special study of human anatomy made in connection with the evolution controversies fitted him in no common degree for investigations of the kind. As to the immediate cause of this new divergence, Sir Charles Lyell, then writing his *Antiquity of Man*, had asked Huxley to help him in some of the anatomical matters, requesting in particular a diagram of the fragmentary prehistoric skull which had recently been discovered in the Neanderthal.

The results of the examination of this skull, and of another from the cave of Engis in the Meuse Valley, were included in a lecture at the Royal Institution, "On the Fossil Remains of Man" (Proc. Roy. Inst., iii, 1858-62, pp. 420-2. Read Friday, February 7, 1862. Sci. Mem., ii, xxviii, p. 509).—Here is the general conclusion reached:—

"Thus it appears that the oldest known races of Man differed comparatively but little in cranial conformation from

those savage races now living, whom they seem to have resembled most in habits; and it may be concluded that these most ancient races at present known were at least as remote from the original stock of the human species as they are from us."

In short, the anatomical as well as the geological evidence pointed to the immense antiquity of the human species, a view which is now universally accepted.

The substance of the foregoing lecture, as of the two delivered the previous year in Edinburgh, was included in *Man's Place in Nature*, which was completed by Huxley in 1862, but of which it will be more convenient to speak under the year of publication (1863).

The controversies about the supposed peculiar characters of the human brain were finally concluded at the British Association Meeting held in Cambridge during this year, when Professor Flower publicly demonstrated that these characters are in fact also to be found in apes. A sarcastic allusion to the unfair tactics of anti-Darwinians appears in a letter written after that meeting:—"A 'Society for the propagation of common honesty in all parts of the world' was established at Cambridge" (Life, i, p. 199). The commodity in question would appear to be more abundant now than then, although this society was not destined to survive for long.

Half a century ago the facts of palæontology then known were often construed adversely to evolution, and early in 1862 this led Huxley to give, as one of the Secretaries of the Geological Society acting for the absent President an "Anniversary Address," which has since become famous (Q. J. Geol. Soc., xviii, 1862, pp. xl-liv. Delivered February 21, 1862. Sci. Mem., ii, xxix, p. 512. Coll. Essays, "Geological Contemporaneity," viii, p. 272). It may be described as a

searching inquiry into palæontological principles and methods, or as the author epigrammatically put it, an attempt to answer the question, "Now, Messieurs les Palæontologues, what the devil *do* you really know?" (Life, i, p. 204). Some of the sentences in Sir Charles Lyell's expressed opinion of the address will best indicate its scope and the manner of its reception (Lyell's Life and Letters, ii, p. 356):—

"Huxley delivered a brilliant critical discourse on what palæontology has and has not done, and proved the value of negative evidence, how much the progressive development system has been pushed too far, . . . the persistency of many forms high and low throughout time, how little we know of the beginning of life upon the earth, how often events called contemporaneous in Geology are applied to things which, instead of coinciding in time, may have happened ten millions of years apart, etc. . . . I never remember an address listened to with such applause, though there were many private protests against some of his bold opinions."

Although the enormous strides made by the subject of late years have necessitated a certain amount of modification in the views advanced, as was of course only to be expected, this address will always remain classical.

The following contributions to palæontology were published during the year:—

1. "On New Labyrinthodonts from the Edinburgh Coal-field" (Q. J. Geol. Soc., xviii, 1862, pp. 291-6. Read May 7, 1862. Sci. Mem., ii, xxx, p. 530).

2. "On a Stalk-eyed Crustacean from the Carboniferous Strata near Paisley (op. cit., xviii, 1862, pp. 420-2. Read June 18, 1862. Sci. Mem., ii, xxxi, p. 536).

3. "On the Premolar Teeth of Diprotodon, and on a New Species of that Genus" (op. cit., xviii, 1862, pp. 422-7. Read June 18, 1862. Sci. Mem., ii, xxxii, p. 539).

4. "Description of a New Specimen of Glyptodon" (Proc. Roy. Soc., xii, 1862-3, pp. 316-26. Read December 18, 1862. Sci. Mem., ii, xxxiii, p. 546).

5. "Description of Anthracosaurus Russellii, a New Labyrinthodont from the Lanarkshire Coal-field" (Q. J. Geol. Soc., xix, 1863, pp. 56-68. Read December 3, 1862. Sci. Mem., ii, xxxv, p. 558).

And to these may be added an ethnological paper:—

6. "Letter on the Human Remains found in the Shell-Mounds" (Trans. Ethnol. Soc., ii, 1863, pp. 265-6. Dated June 28, 1862. Sci. Mem., ii, xxxiv, p. 556). These remains are described as being Papuan in type.

The work of the earlier part of 1862 was accomplished under the disadvantages entailed by very indifferent health, though fortunately some improvement resulted from a July trip to Switzerland with Tyndall. Part of the duties carried out in the second half of the summer were also of out-door character. For as a member of the Fishery Commission (the first of many Commissions on which he afterwards served), dealing with the herring question, he spent some weeks on the Scottish coast for the purpose of observation and inquiry.

In the autumn, too, he entered into the full duties of the Hunterian Professorship at the College of Surgeons, thus having to give some twenty-four lectures on comparative anatomy instead of twelve. This involved a vast amount of dissection, mostly done in the evening, for Huxley was never content to rely upon others for facts where it was possible to get information at first hand. The substance of these lectures was afterwards (1864) published as *Lectures on the Elements of Comparative Anatomy*.

The course of lectures on evolution to working-men,

entitled, "On our Knowledge of the Causes of the Phenomena of Organic Nature," delivered at the end of 1862, was perhaps the most widely appreciated effort of the year. They were taken down in shorthand by one of the auditory, and published with Huxley's permission, but he himself had nothing to do with preparing them for the press. Notwithstanding this, they had a wide vogue in this and other countries, and are included in vol. ii. of the *Collected Essays* (p. 303).

Huxley seems to have been rather surprised by the wide demand for these lectures when they appeared in print, for in a letter to Darwin (dated December 2, 1862), he says :—

"I have no interest in them, and do not desire or intend that they should be widely circulated. . . . There is really nothing new in them nor anything worth your attention, but if in glancing over them at any time you should see anything to object to, I should like to know" (*Life*, i, p. 206).

And again to Hooker (January, 1863) :—

"I never imagined the lectures as delivered would be worth bringing out at all. . . ." (*Life*, i, p. 207).

There can be no question, however, as to the general appreciation of Huxley's popular presentment of Darwinism, from the working-men who made up the audience up to Darwin himself, who wrote (December 18, 1862) :—

"I have read Nos. IV. and V. They are simply perfect. They ought to be largely advertised; but it is very good of me to say so, for I threw down No. IV. with this reflection, 'What is the good of my writing a thundering big book, when everything is in this green little book so despicable for its size?' In the name of all that is good and bad I may as well shut up shop altogether" (*Life*, i, p. 207).

In the Preface (dated April 7, 1893) to vol. ii. of the *Collected Essays*, in speaking of these very lectures, Huxley suggests a course that many would be well advised to follow :—

“It would seem that many people must have found them useful thirty years ago ; and, though the sixties appear now to be reckoned by many of the rising generation as a part of the dark ages, I am not without some grounds for suspecting that there yet remains a fair sprinkling even of ‘philosophic thinkers’ to whom it may be a profitable, perhaps even a novel, task to descend from the heights of speculation and go over the A B C of the great biological problem as it was set before a body of shrewd artizans at that remote epoch.”

Two paragraphs, on the highest aim of life and the proper attitude to maintain towards scientific speculation, respectively, are particularly well worth quoting :—

“So far as I can venture to offer an opinion on such a matter, the purpose of our being in existence, the highest object that human beings can set before themselves, is not the pursuit of any such chimera as the annihilation of the unknown ; but it is simply the unwearied endeavour to remove its boundaries a little further from our little sphere of action.

“Men of science do not pledge themselves to creeds ; they are bound by articles of no sort ; there is not a single belief that it is not a bounden duty with them to hold with a light hand and to part with cheerfully, the moment it is really proved to be contrary to any fact, great or small. And if, in course of time I see good reasons for such a proceeding, I shall have no hesitation in coming before you, and pointing out any change in my opinion without finding the slightest occasion to blush for so doing. So I say that we accept this view as we accept any other, so long as it will help us, and we feel bound to retain it only so long as it will serve our great purpose—the improvement of man’s estate and the widening of his knowledge. The moment this, or any other conception, ceases to be useful for these purposes, away with it to the four winds ; we care not what becomes of it !”

The subsequent progress of events has amply justified the peroration to the last lecture :—

“ . . . In conclusion, let me say that you may go away with it as my mature conviction, that Mr. Darwin's work is the greatest contribution which has been made to biological science since the publication of the *Règne Animal* of Cuvier, and since that of the *History of Development* of Von Baer. I believe that if you strip it of its theoretical part it still remains one of the greatest encyclopædias of biological doctrine that any one man ever brought forth ; and I believe that, if you take it as the embodiment of an hypothesis, it is destined to be the guide of biological and psychological speculation for the next three or four generations.”

CHAPTER IX

MAN'S PLACE IN NATURE—ETHNOLOGY—VIEWS ON EDUCATION [1863-6].

THE first important event of 1863 was the publication of Huxley's first book, *Man's Place in Nature* (Coll. Essays, vii. I, II, and III, pp. 1, *et seq.*). The second and third parts of this ("On the Relations of Man to the Lower Animals," and "On some Fossil Remains of Man") embodied material already brought before the public (*cf.* pp. 59, 63, 65), and to these was prefixed an essay "On the Natural History of the Man-like Apes." To what has elsewhere been said about Parts II. and III., it may be added that the latter includes the description of a very thorough method devised by Huxley of describing and comparing skulls with reference to a number of definite axes, and also a brief sketch of the distribution of the existing races of mankind, classified according to the characters of their skulls, complexion and hair.

The first essay gives a general account of the man-like apes, commencing with a historical sketch of the gradual progress of our knowledge concerning them.

Huxley was warned of the attacks that would follow if he decided to publish. Of the neglect of that warning, and the ensuing adverse criticism, he writes sardonically as follows in the Preface to vol. vii. of the *Collected Essays* (first printed 1894):—

"But, as I have confessed elsewhere, when I was a young man, there was just a little—a mere *souffçon*—in my composition

of that tenacity of purpose which has another name; and I felt sure that all the evil things prophesied would not be so painful to me as the giving up that which I had resolved to do, upon grounds which I conceived to be right. . . . The Boreas of criticism blew his hardest blasts of misrepresentation and ridicule for some years; and I was even as one of the wicked. Indeed, it surprises me, at times, to think how any one who had sunk so low could since have emerged into, at any rate, relative respectability."

The year was spent in vigorous continuance of the numerous varieties of work already begun, much time being spent during the summer and autumn on the duties of the Fishery Commission. One important memoir was completed, — "On the Osteology of the Genus *Glyptodon*," the gigantic extinct armadillo of South America (Phil. Trans. Roy. Soc., clv, 1865, pp. 31-70. Sci. Mem., iii, III, p. 37). This was received by the Royal Society at the end of December, but not read till the following month.

The death of Huxley's brother George in August removed one who had in many ways lightened the burden of his early struggles for a foothold in the scientific world.

1864.

During this year still more time was given to fishery work, and there is also evidence of increasing interest in ethnological matters. The contributions to science were very considerable in amount.

The first volume of the *Lectures on Comparative Anatomy* (the only one published), which had been so long in preparation (*see* p. 68), at last made its appearance, and also an *Atlas of Osteology*, another product of the same line of activity.

An essay entitled "Criticisms on the Origin of

Species" (Coll. Essays, ii, p. 80), deals more particularly with difficulties advanced by Prof. Kölliker and M. Flourens. Of the scientific eminence of the former it is superfluous to speak, but at that date he seems to have misunderstood Darwin in several points. Huxley, consequently, though without sparing full criticism, treated his views with consideration, but very properly handled Flourens in quite another manner :—

“Strongly and freely as we have ventured to disagree with Professor Kölliker, we have always done so with regret, and we trust without violating that respect which is due, not only to his scientific eminence and to the careful study which he has devoted to the subject, but to the perfect fairness of his argumentation, and the generous appreciation of the worth of Mr. Darwin’s labours which he always displays. It would be satisfactory to say as much for M. Flourens. But the Perpetual Secretary of the French Academy of Sciences deals with Mr. Darwin as the first Napoleon would have treated an ‘idéologue’ ; and while displaying a painful weakness of logic and shallowness of information, assumes a tone of authority, which always touches upon the ludicrous, and sometimes passes the limits of good breeding.”

Of scientific memoirs we have the following :—

1. “Further Remarks upon the Human Remains from the Neanderthal” (Nat. Hist. Rev., iv, 1864, pp. 429-46. Sci. Mem., ii, xxxvi, p. 573). — This completes the work of a previous paper (*cf.* p. 65), and in it Huxley thus enjoins the maintenance of a non-committal attitude :—

“The duty of the anatomist appears to me to lie as little in eagerly building theories upon these variations of human structure, as in ignoring them when they are obvious. Let them be noted and estimated at their just weight—the future will tell us their meaning.”

2. “On the Angwántibo (*Arctocebus Calabarensis*, Gray) of Old Calabar” (Proc. Zool. Soc., 1864, pp. 314-

35. *Sci. Mem.*, ii, xxxvii, p. 591).—This monograph on a curious little West African lemur may be regarded as a further proof of the interest in higher mammals which characterized this period.

3. "On the Cetacean Fossils termed 'Ziphius' by Cuvier, with a Notice of a New Species (*Belemnoziphius compressus*) from the Red Crag" (*Q. J. Geol. Soc.*, xx, 1864, pp. 388-96. *Sci. Mem.*, iii, 1, p. 1).—This deals with an extinct whale, of which the teeth are less aberrant than those of existing toothed Cetaceans.

4. "On the Structure of the *Belemnitidæ*; with a Description of a more complete specimen of *Belemnites* than any hitherto known, and an Account of a New Genus of *Belemnitidæ*, '*Xiphoteuthis*'" (*Mem. Geol. Survey, U.K., Monograph II*, 1864. *Sci. Mem.*, iii, 11, p. 11).—*Belemnites* are familiarly known as the fossil remains of extinct creatures related to cuttle-fishes, and characteristic of the Mesozoic epoch. This memoir greatly advanced our knowledge of their structure, and must necessarily be carefully studied by all those interested not merely in the *Belemnitidæ*, but in the evolution of the Molluscan class (*Cephalopoda*), to which the group belongs.

Huxley had considerable faith in the annual examinations held all over the country under the auspices of the Science and Art Department, for in a letter (dated October 6, 1864), pressing Hooker to accept the botanical work involved, he makes the following remark,—

"I have always taken a very great interest in the science examinations, looking upon them, as I do, as the most important engine for forcing science into ordinary education" (*Life*, i, p. 254).

In spite of the abuses (now somewhat ameliorated)

arising from the grant-earning side of these examinations, his opinion as to their use has been largely justified.

The event of greatest private interest that took place in 1864 was the establishment of the celebrated *α* Club at the end of the year, as the result of a suggestion made by Huxley to Hooker. The object was to secure the regular meeting of a small circle of intimate friends, who for various reasons were in some danger of losing touch with one another. The varied branches of science were represented in the persons of the nine members (no others were ever admitted), and as will be seen from the following list these have exerted no small influence upon the progress of science:—

1. George Busk, F.R.S. ; 2. Edward Frankland, For. Sec., R.S., K.C.B. ; 3. Thomas Archer Hirst, F.R.S. ; 4. T. H. Huxley, F.R.S. ; 5. Joseph Dalton Hooker, F.R.S., K.C.S.I. ; 6. Sir John Lubbock, Bart., F.R.S., M.P. ; 7. Herbert Spencer ; 8. William Spottiswoode, Treasurer R.S. ; 9. John Tyndall, F.R.S. Mr. Leonard Huxley justly remarks:—

“Small as the Club was, the members of it were destined to play a considerable part in the history of English science. Five of them received the Royal Medal; three the Copley; one the Rumford; six were Presidents of the British Association; three Associates of the Institute of France; and from amongst them the Royal Society chose a Secretary, a Foreign Secretary, a Treasurer, and three successive Presidents” (Life, i, p. 258).

The members of the Club dined together on the first Thursday of every month, save July, August and September, and there were 240 meetings in all (1864-93). The first gap in the ranks was created by the death of Spottiswoode in 1883.

1865.

1865 affords one or two interesting glimpses of Huxley's educational opinions, which were markedly in advance of the time. An essay entitled "Emancipation—Black and White" (Coll. Essays, iii, p. 66), after discussing the question of slavery, which the American Civil War had made a burning one, deals with the higher education of women and related matters. The statement is unhesitatingly made that the average negro is not the equal of the average white man, but that this does not justify an infraction of the moral law,

" . . . That no human being can arbitrarily dominate over another without grievous damage to his own nature. . . "

Emancipated negroes will be unable to attain the highest places, but need not remain in the lowest :—

" But whatever the position of stable equilibrium into which the laws of social gravitation may bring the negro, all responsibility for the result will henceforward lie between Nature and him. The white man may wash his hands of it, and the Caucasian conscience be void of reproach for evermore. And this, if we look to the bottom of the matter, is the real justification for the abolition policy."

The emancipation of girls as regards education is then advocated, for,

" The mind of the average girl is less different from that of the average boy, than the mind of one boy is from that of another ; so that whatever argument justifies a given education for all boys, justifies its application to girls as well. So far from imposing artificial restrictions upon the acquirement of knowledge by women, throw every facility in their way."

The result to be anticipated is that,

" Women will find their place, and it will neither be that in

which they have been held, nor that to which some of them aspire."

Since then the higher education of women has made extraordinary advances, and there would seem to be much truth in this prophecy made forty years ago.

During the summer he gave his hearty support to the International Education Society, which then commenced its work. An International College was founded at Isleworth for the purpose of giving practical expression to the views of the Society, which included the establishment of similar and related institutions in France and Germany. The aim was to provide a liberal education for boys, which in its earlier stages would be the same for all pupils, whether destined to become professional men, or to engage in commercial pursuits.

The chief distinguishing features of the course were to be proper provision for instruction in the elements of physical and social science, and in three modern languages (English, French, and German), these to be acquired by dividing the course of a pupil between the three colleges. The physical science was to include the topics dealt with by Huxley in his preliminary lectures at the Royal School of Mines, and afterwards embodied in his work on *Physiography*, the equivalent of the German "Erdkunde." The Franco-Prussian war unfortunately prevented this most interesting scheme from coming to fruition.

It will be seen that the views of the International Education Society have steadily made headway in this country, and they will continue to do so. Thanks to the efforts of Huxley and other educational pioneers, the claims of natural science are now largely admitted, and effect given to the admission. The recognition of

“Citizenship” as a subject expresses the necessity for imparting the main ideas of social science, and the crying need for a living knowledge of living languages is increasingly realized. The exchange of teachers which is now arranged between England, France and Germany illustrates the last point.

During the preceding winter Huxley’s continued interest in ethnology was evinced by the fact that his lectures to working-men were on “The Various Races of Mankind,” and some of his views on the subject are included in a paper in the *Fortnightly Review*, entitled “On the Methods and Results of Ethnology” (Coll. Essays, vii, 209). In this the value of philology as a primary aid to investigation is discounted, a modified classification of races put forward, and the unity of the human species supported. The essay embodies the substance of a Friday Evening Discourse delivered at the Royal Institution (June 2, 1865) on the same subject (Proc. Roy. Inst., iv, 1862-6, pp. 461-3. Sci. Mem., iii, vi, p. 121). In this he,

“. . . endeavoured to show in what way the application of Mr. Darwin’s views to Ethnology reconciles the doctrine of anatomical unity with that of persistence of modification, and overcomes difficulties of distribution by taking into account the facts of geological change.”

The two following scientific memoirs bear date 1865:—

1. “On the Structure of the Stomach in *Desmodus rufus*” (Proc. Zool. Soc., 1865, pp. 386-90. Read April 11, 1865. Sci. Mem., iii, iv, p. 85). The stomach of this blood-sucking bat is shown to be peculiarly modified in adaptation to the nature of the food.

2. "On a Collection of Vertebrate Fossils from the Panchet Rocks, Ranigunj, Bengal" (Mem. Geol. Survey, India; *Palæontologica Indica*, i, 1865-85, pp. 3-24. Sci. Mem. iii, v, p. 90).—This memoir deals with a number of fragmentary remains belonging to members of extinct groups of Amphibia and Reptilia.

To the same year belongs the "Explanatory Preface to the Catalogue of the Palæontological Collection in the Museum of Practical Geology," which includes a "Brief Exposition of certain Principles of Natural History," and the "Application of Natural History to the Elucidation of Fossils, or Palæontology" (Sci. Mem., iii, vii, p. 125).

1866.

Up to 1866 Huxley's work had received no academic recognition in Britain, but on April 2, of that year, the LL.D. (*honoris causâ*) of Edinburgh was conferred upon him, in company with Tyndall and Carlyle, the one his intimate friend, and the other a man whose writings had long before played an important part in the formation of his character (see p. 3).

The love of fair-play which Huxley consistently displayed under all circumstances was illustrated this year by his becoming a member of the Jamaica Committee. The object of this was to prosecute Governor Eyre for murder, he having summarily executed a negro named Gordon, who was concerned in a rising of the coloured population of the island. The affair excited extraordinary interest in this country, and gave rise to no little feeling. Many men of distinction joined the committee, while others organized a counter-committee for the defence of Eyre.

Huxley's position in the matter is sufficiently indicated in a letter to Kingsley (dated November 8, 1866), where, after disclaiming any admiration for Gordon, who is described as,

“ . . . a sufficiently poor type of small political agitator—and very likely . . . a great nuisance to the Governor and other respectable persons,”

he adds :—

“ But that is no reason why he should be condemned, by an absurd tribunal and with a brutal mockery of the forms of justice, for offences with which impartial judges, after a full investigation, declare there is no evidence to show that he was connected ” (Life, i, pp. 281-2).

Huxley was President of Section D in the British Association Meeting at Nottingham this year, and in this capacity he took occasion to speak strongly as to the necessity for organized science teaching in schools, and the proper recognition of science in universities. A paper on the teaching of science in public schools by Dean Farrar lent strong support to the views of Huxley, who expressed his conviction,

“ . . . that at the present time, the important question for England was not the duration of her coal, but the due comprehension of the truths of science, and the labours of her scientific men ” (Life, i, p. 277).

The interchange of opinions which took place at Nottingham afterwards bore fruit, for it had something to do with the organization of courses for teachers in training in which Huxley afterwards took a prominent part.

The publication of *Elementary Lessons in Physiology* in

1866 was also destined to play no unimportant part in the furtherance of science teaching in this country. Written with inimitable lucidity, it illustrates Huxley's leaning towards the physiological side of biology, and his admirable expository powers, and has deservedly attained a measure of popularity rarely if ever excelled by works of the kind.

A lay sermon "On the Advisableness of Improving Natural Knowledge (Coll. Essays, i, p. 18), delivered at St. Martin's Hall (on Sunday evening, November 8), clearly sets forth the importance of the movement initiated by the foundation of the Royal Society, in the latter part of the seventeenth century. The aims, methods and ideals of natural science are here luminously presented, and its wide-reaching influence in the future predicted with a confidence which has since been fully justified. The following passages will be familiar to many readers:—

"However, there are blind leaders of the blind, and not a few of them, who take this view of natural knowledge [*i.e.*, the purely utilitarian one], and can see nothing in the bountiful mother of humanity but a sort of comfort-grinding machine. According to them, the improvement of natural knowledge always has been, and always must be, synonymous with no more than the improvement of the material resources and the increase of the gratification of men.

"I say that natural knowledge, seeking to satisfy natural wants, has found the ideas which can alone still spiritual cravings. I say that natural knowledge, in desiring to ascertain the laws of comfort, has been driven to discover those of conduct, and to lay the foundations of a new morality.

"But in this sadness [*i.e.*, as expressed in Homer], this consciousness of the limitation of man, this sense of an open secret which he cannot penetrate, lies the essence of all religion; and the attempt to embody it in the forms furnished by the intellect, is the origin of the higher theologies.

"The improver of natural knowledge absolutely refuses to

acknowledge authority, as such. For him, scepticism is the highest of duties; blind faith the one unpardonable sin.

“If these ideas be destined, as I believe they are, to be more and more firmly established as the world grows older; if that spirit be fated, as I believe it is, to extend itself into all departments of human thought, and to become co-extensive with the range of knowledge; if, as our race approaches its maturity, it discovers, as I believe it will, that there is but one kind of knowledge and but one method of acquiring it; then we, who are still children, may justly feel it our highest duty to recognise the advisableness of improving natural knowledge, and so to aid ourselves and our successors in our course towards the noble goal which lies before mankind.”

Continued interest in ethnology is manifested by the publication of a paper on “Prehistoric Remains in Caithness” in the *Natural History Review* for February, and in the sympathy expressed with a scheme brought before the Asiatic Society by Dr. Fayrer for the promotion of anthropological research in South Asia.

The following palæontological memoirs also belong to 1866:—

1. “British Fossils. Illustrations of the Structure of the Crossopterygian Ganoids” (Mem. Geol. Survey, U.K., Decade XII, 1866. Sci. Mem., Supply. Vol. II, p. 20).—This deals with the genera *Glytopomus*, *Cœlacanthus*, *Macropoma* and *Holophagus*, and is a continuation of work to which allusion has already been made (see p. 62).

2. “On a Collection of Fossil Vertebrata, from the Jarrow Colliery, County of Kilkenny, Ireland” (Trans. Roy. Irish Acad., xxiv, 1871, pp. 351-69. Read January 6, 1866. Sci. Mem., iii, viii, p. 180).—The extinct vertebrates in question are *Amphibia* (*Labyrinthodonts*).

3. “On Some Remains of large Dinosaurian Reptiles from the Stormberg Mountains, South Africa” (Q. J.

Geol. Soc., xxiii, 1867, pp. 1-6. Read November 7, 1866. *Sci. Mem.*, iii, ix, p. 198).

4. "On a New Specimen of *Telerpeton Elginense*" (op. cit., xxiii, 1867, pp. 77-84. Read December 19, 1866. *Sci. Mem.*, iii, x, p. 205).—This describes a very ancient extinct reptile.

CHAPTER X

BIRDS AND REPTILES—PROTOPLASM—AGNOSTICISM
[1867-69].

AMONG Huxley's Continental friends Haeckel had long been reckoned, and during 1867, when the family were staying at Swanage, a visit paid by Dr. Anton Dohrn marked the beginning of another warm intimacy of the kind. In a letter to the former (dated July 16, 1867), congratulating him on his betrothal, and one to the latter written (September 22) after the visit to Swanage, we get pleasing glimpses of the home life in which Huxley particularly delighted, and which alone rendered his immense output of work possible. At this time his children were seven in number, the eldest being ten years old. "Go and see the Huxley family at Swanage," was suggested by Dohrn as a completely satisfactory definition of happiness (*Life*, i, p. 291).

The last course of lectures as Fullerian Professor of Physiology was delivered at the Royal Institution this year, Huxley finding it necessary to give up this part of his work as being in various ways too exacting, and trenching too much upon the time available for original research. The three following memoirs bear date 1867:—

1. "On Two Widely Contrasted Forms of the Human Cranium" (*J. Anat. and Physiol.*, i, 1867, pp. 60-77. *Sci. Mem.*, iii, xi, p. 214).—A detailed comparison is made in this paper between a broad-headed (brachy-

cephalic) Tartar skull, and a long-headed (dolichocephalic) one of Australian type.

2. "On *Acanthopholis horridus*, a New Reptile from the Chalk-marl" (*Geol. Mag.*, iv, 1867, pp. 65-7. *Sci. Mem.*, iii, xii, p. 231).—This is a short account of some fragmentary remains belonging to a Dinosaur.

3. "On the Classification of Birds; and on the Taxonomic Value of the Modifications of Certain of the Cranial Bones observable in that Class" (*Proc. Zool. Soc.*, 1867, pp. 415-72. Read April 11, 1867. *Sci. Mem.*, iii, xiii, p. 239).—This epoch-making paper, the result of work commenced some years previously (*cf.* p. 63), is an attempt to classify a notoriously difficult group upon new principles, and the supposed actual relationships between the subdivisions thus constituted are indicated.

1868.

Three addresses given during 1868 are remarkable in various ways. One of them, "A Liberal Education; and where to find it" (*Coll. Essays*, iii, p. 76), delivered at the South London Working-Men's College, sets forth the crying need for an all-round education involving real training of the mind, makes a scathing indictment against all stages of education in Britain as then carried out, and sketches the result to be expected from the system of education advocated, in the following notable passages:—

"That man, I think, has had a liberal education, who has been so trained in youth that his body is the ready servant of his will, and does with ease and pleasure all the work that as a mechanism it is capable of; whose intellect is a clear, cold, logic engine, with all its parts of equal strength, and in smooth, working order; ready, like a steam engine, to be turned to any kind of work, and spin the gossamers as well as forge the anchors of the mind; whose mind is stored with a knowledge of the great

and fundamental truths of nature and of the laws of her operations; one who, no stunted ascetic, is full of life and fire, but whose passions are trained to come to heel by a vigorous will, the servant of a tender conscience; who has learned to love all beauty, whether of nature or of art, to hate all vileness, and to respect others as himself.

“Such an one and no other, I conceive, has had a liberal education, for he is as completely as a man can be, in harmony with nature. He will make the best of her, and she of him. They will get on together rarely; she as his ever beneficent mother; he as her mouth-piece, her conscious self, her minister and interpreter.”

The second address “On a Piece of Chalk” (Coll. Essays, viii, p. 1), was delivered to the working-men of Norwich during the meeting of the British Association. Here Mr. Leonard Huxley (Life, i, p. 297) may with advantage be quoted:—

“This lecture ‘On a Piece of Chalk,’ together with two others delivered this year, seem to me to mark the maturing of his style into that mastery of clear expression for which he deliberately laboured, the saying exactly what he meant, neither too much nor too little, without confusion and without obscurity. Have something to say, and say it, was the Duke of Wellington’s theory of style; Huxley’s was to say that which has to be said in such language that you can stand cross-examination on each word. Be clear, though you may get convicted of error. If you are clearly wrong, you will run up against a fact sometime and get set right. If you shuffle with your subject, and study chiefly to use language which will give a loophole of escape either way, there is no hope for you.

“This was the secret of his lucidity. In no one could Buffon’s aphorism on style find a better illustration, *Le style c’est l’homme même*. In him science and literature, too often divorced, were closely united; showing that truthfulness need not be bald, and that real power lies more in exact accuracy than in luxuriance of diction. Years after, no less an authority than Spedding, in a letter upon the influence of Bacon on his own style in the matter of exactitude, the pruning of fine epithets

and sweeping statements, the reduction of numberless superlatives to positives, asserted that, if as a young man he had fallen in with Huxley's writings before Bacon's, they would have produced the same effect upon him."

The address upon Chalk is noteworthy in a variety of ways. For one thing it marks the increasing interest which men of science were beginning to take in deep-sea life, and which culminated in the equipment and despatch of the *Challenger* expedition towards the end of 1872.

The third address, given during 1868, "On the Physical Basis of Life" (Coll. Essays, i, p. 130), was delivered in Edinburgh as a lay sermon (Sunday evening, November 8), and attracted an unusual amount of attention, friendly and otherwise.

In a note (dated 1892) to the reprint of this essay, Huxley remarks:—

"I cannot say I have ever had to complain of lack of hostile criticism; but the preceding essay has come in for more than its fair share of that commodity."

Yet its main object was simply to show that all the manifestations of life as we know it, whether in plants or animals, are associated with a physical substratum of the same character, *i.e.*, protoplasm; teaching which is now embodied in every elementary course of biology. But after carrying this thesis to its logical conclusion, Huxley expressly says:—

". . . I, individually, am no materialist, but, on the contrary, believe materialism to involve grave philosophical error. This union of materialistic terminology with the repudiation of materialistic philosophy I share with some of the most thoughtful men with whom I am acquainted."

The address also includes a criticism of the position taken up by Archbishop Thomson, who, in his lecture

“On the Limits of Philosophical Inquiry,” identified Comtism with the “New Philosophy” (*i.e.*, the spirit of modern science), and further credited Comte with doctrines that should have been attributed to David Hume. Huxley’s own philosophic views owed much to the influence of the latter, as will subsequently become apparent.

The following scientific memoirs belong to 1868:—

1. “Remarks upon *Archæopteryx lithographica*” (Proc. Roy. Soc., xvi, pp. 243-8. Read January 30, 1868. Sci. Mem., iii, xviii, p. 340).—This deals with the oldest extinct bird, a form presenting several well-marked reptilian features, of which the most striking then known was the possession of a long jointed tail, bearing, however, pairs of quill feathers. The following remark is of prophetic interest:—

“If when the head of *Archæopteryx* is discovered, its jaws contain teeth, it will not the more, to my mind, cease to be a bird, than turtles cease to be reptiles, because they have beaks.”

It is now a familiar fact that when a complete specimen of *Archæopteryx* was subsequently found, it proved to be a tooth-bearing form:

2. “On *Saurosternon Bainii* and *Pristerodon M’Kayi*, two New Lacertilian Reptiles [*i.e.*, lizards] from South Africa” (Geol. Mag., v, 1868, pp. 201-5. Sci. Mem., iii, xiv, p. 298).

3. “On the Animals which are Most Nearly Intermediate between Birds and Reptiles” (op. cit., v, 1868, pp. 357-65. Sci. Mem., iii, xv, p. 303).—This deals with the extinct group of Dinosaurs, some of which resemble birds in certain anatomical characters. It embodies the substance of an address delivered at the Royal Institution on February 7, and is in part the outcome of the work on *Archæopteryx* (*vide supra*).

4. "On the Formation of the Cranium among the Patagonians and the Fuegians, with Some Remarks upon American Crania in General" (*J. Anat. and Physiol.*, ii, 1868, pp. 253-71. *Sci. Mem.*, iii, xvi, p. 314).

5. "On Some Organisms Living at Great Depths in the North Atlantic Ocean" (*Q. J. Micros. Sci.*, New Series, viii, 1868, pp. 203-12. *Sci. Mem.*, iii, xvii, p. 330).—The chief scientific interest of this paper is the description of certain indefinite gelatinous masses found in preserved Atlantic dredgings under the name of "Bathybius Haeckelii," supposed to be a primitive organism ("Ur-schleim"). This view, afterwards fully recanted (see p. 154), was founded on one of Huxley's very few observational errors.

6. "On the Classification and Distribution of the Alectoromorphæ [*i.e.*, game birds] and Heteromorphæ" (*Proc. Zool. Soc.*, 1868, pp. 294-319. Read May 14, 1868. *Sci. Mem.*, iii, xix, p. 346).—This important extension of Huxley's work on birds assigns the aberrant South American form *Opisthocomus* to a separate group (Heteromorphæ), most nearly related to game birds and pigeons. It also includes his views on the division of the land into distributional regions, and gives the name "Wallace's Line" to the boundary between the Australian and Oriental realms.

1869.

The many-sided activities of 1869 included a further development of Huxley's views on the place of science in education. On April 7, for example, he spoke at the Liverpool Philomathic Society on "Scientific Education: Notes of an After-dinner Speech" (*Coll. Essays*, iii, p. 111). The lecture alludes to the increas-

ing recognition of the claims of science, and dwells on its importance to various sections of the community, both from the practical standpoint, and as a means of training the mind. The widespread ignorance of physical science on the part of the Protestant clergy is deplored, and they are spoken of as—

“ . . . at present divisible into three sections: an immense body who are ignorant and speak out; a small proportion who know and are silent; and a minute minority who know and speak according to their knowledge.”

A tribute is paid to the thorough training given by the Roman Catholic Church to its priests:—

“ Our great antagonist—I speak as a man of science—the Roman Catholic Church, the one great spiritual organization which is able to resist, and must, as a matter of life and death, resist, the progress of science and modern civilization, manages her affairs much better.”

Then follows a sketch of Huxley's views as to the nature of an ideal school course in physical science, beginning with observation of facts and ending with practical training in scientific method.

These views were no new thing, and he had for many years given them expression in preliminary lectures to the Jermyn Street course (see p. 37), but now, for the first time, the elements of physiography were brought before an audience primarily of school-boys at the London Institution during April, May, and June. The lectures were repeated in November, at South Kensington Museum, as part of a course for women. They afterwards appeared, in book form, under the title *Physiography* (1877), and exerted a widespread influence upon elementary science teaching.

That increasing importance was being attached to

science at this time is indicated by the foundation of the Metaphysical Society in 1869, with the object of bringing together leading thinkers of diverse opinions as regards the "New Philosophy" (*cf.* p. 89). The credit of the idea is due to James Knowles, and the Society, which was not long-lived, justified its existence by enabling a number of misconceptions to be cleared up, with no small gain in the matter of mutual respect. The composition of the Society is described as follows by Mr. Leonard Huxley (*Life*, i, p. 314):—

"Thus the Society came to be composed of men of the most opposite ways of thinking and of very various occupations in life. The largest group was that of churchmen:—ecclesiastical dignitaries such as Thomson, the Archbishop of York, Ellicott, Bishop of Gloucester and Bristol, and Dean Alford; staunch laymen such as Mr. Gladstone, Lord Selborne, and the Duke of Argyll; while the liberal school was represented by Dean Stanley, F. D. Maurice, and Mark Pattison. Three distinguished converts from the English Church championed Roman Catholic doctrine—Cardinal Manning, Father Dalgairns, and W. G. Ward, while Unitarianism claimed Dr. James Martineau. At the opposite pole, in antagonism to Christian theology and theism generally, stood Professor W. K. Clifford, whose youthful brilliancy was destined to be cut short by an untimely death. Positivism was represented by Mr. Frederic Harrison; and Agnosticism by such men of science or letters as Huxley and Tyndall, Mr. John Morley, and Mr. Leslie Stephen.

"Something was gained, too, by the variety of callings followed by the different members. While there were professional students of philosophy, like Professor Henry Sidgwick or Sir Alexander Grant, the Principal of Edinburgh University, in some the technical knowledge of philosophy was overlaid by studies in history or letters; in others, by the practical experience of the law or politics; in others, again, medicine or biology supplied a powerful psychological instrument. This fact tended to keep the discussions in touch with reality on many sides.

"There was Tennyson, for instance, the only poet who thoroughly understood the movement of modern science, a stately but silent member; Mr. Ruskin, J. A. Froude, Shadworth

Hodgson, R. H. Hutton of the *Spectator*, James Hinton, and the well-known essayist, W. R. Greg; Sir James Fitzjames Stephen, Sir F. Pollock, Robert Lowe (Lord Sherbrooke), Sir M. E. Grant Duff, and Lord Arthur Russell; Sir John Lubbock, Dr. W. B. Carpenter, Sir William Gull, and Sir Andrew Clark."

It would seem that the debates of the Society were singularly free from remarks of a personal character, and indeed it was expressly understood that this should be so. The only passage-at-arms of the kind appears to have been between W. G. Ward and Huxley, at a meeting where someone had suggested that such methods of expression ought to be sedulously avoided. Upon which Ward remarked :—

"While acquiescing in this condition as a general rule, I think it cannot be expected that Christian thinkers shall give no sign of the horror with which they would view the spread of such extreme opinions as those advocated by Mr. Huxley."

Which immediately elicited the retort :—

"As Dr. Ward has spoken, I must in fairness say, that it will be very difficult for me to conceal my feeling as to the intellectual degradation which would come of the general acceptance of such views as Dr. Ward holds" (*Life of Dr. W. G. Ward*, p. 309).

This practical illustration of what might be expected if personalities were not to be avoided, settled once for all the way in which discussions would have to be conducted if the object of the Society was not to be frustrated.

The word "agnostic" was coined by Huxley after he entered the Metaphysical Society, in order to express the non-committal attitude he felt bound to adopt towards religious problems. As an unusually keen debater, with

an unrivalled critical faculty, he uncompromisingly attacked the dogmatic statements of some of his fellow-members, and himself contributed the following three papers:—1. "The Views of Hume, Kant, and Whately on the logical basis of the doctrine of the Immortality of the Soul" (November 17, 1869); 2. "Has a Frog a Soul? and if so, of what Nature is that Soul?" (November 8, 1870); 3. "Evidence of the Miracle of the Resurrection" (January 11, 1876).

Huxley was President of the Geological and Ethnological Societies in 1869, and at the Exeter Meeting of the British Association was elected as President for the following year, Liverpool being adopted as the place to be visited. The still increasing quantity of work in which he was immersed obliged him to resign the Hunterian Professorship at the Royal College of Surgeons. The following list of memoirs for the year will give some idea of his scientific activity at this time.

1. "The Anniversary Address of the President" (Q. J. Geol. Soc., xxv. 1869, pp. xxviii.-liii. Delivered February 19, 1869. Sci. Mem., iii, xxiii, p. 397. Coll. Essays, as "Geological Reform," viii, p. 305).—This paid the usual tributes to the memories of deceased Fellows, including in this case Bouchers de Perthes and M. A. Morlot, eminent workers on prehistoric man in France and Switzerland, Principal Forbes and Sir David Brewster. The address itself was on the subject of "Geological Reform," and had reference to the time-limits which Sir William Thomson (now Lord Kelvin), from the physical standpoint, had imposed upon geology in his work "On Geological Time" (Trans. Geol. Soc., Glasgow, iii). While admitting the necessity for accepting time-limits of the kind, Huxley put forward a caveat

against accepting mathematical deductions unless the premises were absolutely matters of fact :—

“ Mathematics may be compared to a mill of exquisite workmanship, which grinds you stuff of any degree of fineness ; but, nevertheless, what you get out depends upon what you put in ; and as the grandest mill in the world will not extract wheat-flour from peas-cods, so pages of formulæ will not get a definite result out of loose data.”

The chief interest of the address lies in the recognition of the fact that the progress of scientific thought necessitated some modification of the Uniformitarian attitude, and the adoption of “ Evolutionism ” instead.

2. “ On Hyperodapedon ” (op. cit., xxv, 1869, pp. 138-52. Read January 13, 1869. Sci. Mem., iii, xx, p. 374).—This extinct reptile is shown to resemble the existing Hatteria of New Zealand, the only living representative of its order.

3. “ On a new Labyrinthodont from Bradford ” (op. cit., xxv, 1869, pp. 309-11. Read May 26, 1869. Sci. Mem., iii, XXI, p. 391).—This describes Pholiderpeton, an extinct Amphibian.

4. “ On the Upper Jaw of Megalosaurus ” (op. cit., xxv, 1869, pp. 311-14. Read May 26, 1869. Sci. Mem., iii, xxii, p. 394).—The huge extinct reptile in question is a carnivorous member of the extinct group of Dinosauria.

5. “ On Hypsilophodon Foxii, a New Dinosaurian from the Wealden of the Isle of Wight ” (op. cit., xxvi, 1870, pp. 3-12. Read November 10, 1869. Sci. Mem., iii, xxvii, p. 454).

6. “ Further Evidence of the Affinity between the Dinosaurian Reptiles and Birds ” (op. cit., xxvi, 1870, pp. 12-31. Read November 10, 1869. Sci. Mem., iii, xxviii, p. 465).—In this memoir views previously advanced (*cf.* p. 89) are elaborated.

7. "On the Classification of Dinosauria, with Observations on the Dinosauria of the Trias" (op. cit., xxvi, 1870, pp. 32-50. Read November 24, 1869. Sci. Mem. iii, xxix, p. 487). One interesting point in this paper is the endeavour to show that the area of distribution "Arctogæa," including the northern parts of the land of both hemispheres, has existed from a remote geological epoch.

8. "On the Ethnology and Archæology of India. Opening Address of the President" (J. Ethnol. Soc., New Ser., i, 1869, pp. 89-93. Delivered March 9, 1869. Sci. Mem., iii, xxiv, p. 427).—This was the outcome of work undertaken in connection with Fayrer's scheme, to which allusion has already been made (see p. 83).

9. "On the Ethnology and Archæology of North America" (op. cit., i, 1869, pp. 218-21. Delivered April 13, 1869. Sci. Mem., iii, xxv, p. 432).

10. "On the Representatives of the Malleus and Incus of the Mammalia in other Vertebrata" (Proc. Zool. Soc., 1869, pp. 391-407. Read May 27, 1869. Sci. Mem., iii, xxvi, p. 436).—This is an important contribution to the literature regarding two of the minute bones which convey sound-vibrations across the drum of the ear. The views of Professor Peters are criticized, and others advanced.

During 1869, Huxley also wrote an interesting critique, "The Genealogy of Animals" (Coll. Essays, ii, p. 107) on the important work, *The Natural History of Creation* ("Natürliche Schöpfungs-Geschichte," Berlin, 1868), put out by his friend, Professor Haeckel of Jena, of whom he says:—

"Considering that Germany now takes the lead of the world in scientific investigations, and particularly in biology, Mr. Darwin

must be well pleased at the rapid spread of his views among some of the ablest and most laborious of German naturalists. Among these, Professor Haeckel, of Jena, is the Coryphæus."

The *Introduction to the Classification of Animals*, published in 1869, was not a new work but a partial reprint of the lectures on *Elementary Comparative Anatomy*, issued in 1864.

CHAPTER XI

OFFICIAL AND ADMINISTRATIVE WORK [1870-71].

THE year 1870 may be taken as the beginning of a new stage in Huxley's life, involving an increase in official and administrative duties, with consequent diminution in the amount of original work. The last point is sufficiently illustrated by the fact that three out of the four large volumes in which his *Scientific Memoirs* have been issued in a collected form are taken up with the results of researches carried out before 1873.

Much time was in future to be occupied by the duties involved in serving on various Commissions. Before 1870 he had already been a member of four of these, *i.e.* :

1. Royal Commission on the Operation of Acts relating to Trawling for Herrings on the Coast of Scotland (1862).
2. Royal Commission to inquire into the Sea Fisheries of the United Kingdom (1864-5).
3. Commission on the Royal College of Science for Ireland (1866).
4. Commission on Science and Art Instruction in Ireland (1868).

The Commissions with which he was concerned from 1870 onwards were as follows:—

5. Royal Commission upon the Administration and Operation of the Contagious Diseases Acts (1870-1).
6. Royal Commission on Scientific Instruction and the Advancement of Science (1870-5).
7. Royal Commission on the Practice of subjecting Live Animals to Experiments for Scientific Purposes (1876).
8. Royal Commission to inquire into the Universities of Scotland (1876-8).
9. Royal Commission on the Medical Acts (1881-2).
10. Royal

Commission on Trawl, Net and Beam Trawl Fishing (1884).

Administrative work in connection with various learned societies consumed an increasing amount of time, especially the heavy duties associated with the Secretaryship of the Royal Society, which he held from 1872-81, afterwards becoming President (1883-5).

Before 1870 Huxley had not been content merely with demonstrating, by the example of his own courses, the methods which ought to be employed in order to make the specialist teaching of science really efficient, but he had also taken every opportunity of expressing his views as to the place of science in a school curriculum, and as to the unsatisfactory nature of school education in Britain (*cf.* p. 91). Largely as the result of the part he played in the intellectual renaissance to which the theory of evolution gave so powerful an impetus, profound discontent had gradually arisen in this country with the disorganized state of elementary education, which found practical expression in the passing of W. E. Forster's Education Act in 1870.

Huxley fortunately conceived it to be his duty to offer himself as a candidate for the first London School Board, and without taking any steps beyond some addresses given at public meetings, was returned for the Marylebone division on November 29, being second on the poll. His reasons for coming forward are thus summarized by Mr. Leonard Huxley (*Life*, i, p. 337):—

“ This [*i.e.*, the London School Board] was the practical outcome of the rising interest in education all over the country; on its working, he felt, depended momentous issues—the fostering of the moral and physical well-being of the nation; the quickening of its intelligence and the maintenance of its commercial supremacy. Withal, he desired to temper ‘book-learning’ with

something of the direct knowledge of nature : on the one hand, as an admirable instrument of education, if properly applied; on the other, as preparing the way for an attitude of mind which could appreciate the reasons for the immense changes already beginning to operate in human thought."

In an article in the *Contemporary Review* (1870) on "The School Boards : what they can do, and what they may do" (Coll. Essays, iii, p. 374), we find a sketch of what Huxley considered elementary education should include, arranged under four heads :— " 1. Physical training and drill, as part of the regular business of the school. 2. Next in order to physical training I put the instruction of children, and especially of girls, in the elements of household work and of domestic economy ; in the first place for their own sakes, and in the second for that of their future employers." 3. Ethical and religious training. 4. Intellectual training, including not only reading, writing and arithmetic, but also the elements of physical science, with drawing, modelling and singing.

The considerations advanced under the third heading are in these days of particular interest. One provision of the Act ran as follows :—

"No religious catechism or religious formulary which is distinctive of any particular denomination shall be taught in the school."

Mr. Forster afterwards defined the kind of religious instruction permitted by the Act :—

"I have the fullest confidence that in the reading and explaining of the Bible, what the children will be taught will be the great truths of Christian life and conduct, which all of us desire they should know, and that no effort will be made to cram into their poor little minds theological dogmas which their tender age prevents them from understanding."

In the article now under consideration Huxley very

clearly defines his own position in regard to the religious question, and since that position has been much misunderstood and often misrepresented, it will be well to make it clear. He deplores the current confusion between religion and theology, beginning with the statement that, from the intellectual side, the laws of conduct are a part of moral science, while, "all that has any unchangeable reality in religion" is beyond science, and constituted by

"... the engagement of the affections in favour of that particular kind of conduct which we call good . . . together with the awe and reverence, which have no kinship with base fear, but arise whenever one tries to pierce below the surface of things, whether they be material or spiritual. . . ."

Elsewhere he gives the brief definition :—

"Teach a child what is wise, that is *morality*. Teach him what is wise and beautiful, that is *religion*" (Life, i, p. 343, Note 1).

This naturally calls to mind one of the Platonic ideals, as expressed in the following passage, which follows Plato's criticism of poets :—

"This being the case, ought we to confine ourselves to superintending our poets, and compelling them to impress on their productions the likeness of a good moral character, on pain of not composing among us ; or ought we to extend our superintendence to the professors of every other craft as well . . . ? Ought we not, on the contrary, to seek out artists of another stamp, who, by the power of genius can trace out the nature of the fair and the graceful, that our young men, dwelling as it were in a healthful region, may drink in good from every quarter, whence any emanation from noble works may strike upon their eye or their ear, like a gale wafting health from salubrious lands, and win them imperceptibly from their earliest childhood into resemblance, love, and harmony with the true beauty of reason ?" (The Republic of Plato, translation of Davies and Vaughan, new edition, 1874, pp. 96-7).

Huxley was undoubtedly a supporter of secular education, defined as "education without theology," but there were then as now secularists and secularists, and so far from being the leader of those included in the first London School Board, he was entirely opposed to their views, quite as much as to those of the so-called "religious party":—

"For, leaving aside the more far-seeing minority on each side, what the 'religious' party is crying for is mere theology, under the name of religion; while the 'secularists' have unwisely and wrongfully admitted the assumption of their opponents, and demand the abolition of all 'religious' teaching, when they only want to be free of theology—burning your ship to get rid of the cockroaches!"

And further:—

". . . If I were compelled to choose for one of my own children, between a school in which real religious instruction is given, and one without it, I should prefer the former, even though the child might have to take a good deal of theology with it."

Huxley's eloquent plea for the use of the Bible in schools, as the only practical measure by which "the religious feeling, which is the essential basis of conduct," can be kept up in this country, has often been quoted, but will bear quoting again:—

"Take the Bible as a whole; make the severest deductions which fair criticism can dictate for shortcomings and positive errors; eliminate, as a sensible lay-teacher would do, if left to himself, all that it is not desirable for children to occupy themselves with; and there still remains in this old literature a vast residuum of moral beauty and grandeur. And then consider the great historical fact that, for three centuries, this book has been woven into the life of all that is best and noblest in English history; that it has become the national epic of Britain, and is as familiar to noble and simple, from John o' Groats

House to Land's End, as Dante and Tasso once were to the Italians; that it is written in the noblest and purest English, and abounds in exquisite beauties of mere literary form; and finally, that it forbids the veriest hind who never left his village to be ignorant of the existence of other countries and other civilizations, and of a great past, stretching back to the furthest limits of the oldest nations in the world. By the study of what other book could children be so much humanized and made to feel that each figure in that vast historical procession fills, like themselves, but a momentary space in the interval between two eternities; and earns the blessings or the curses of all time, according to its effort to do good and hate evil, even as they also are earning their payment for their work?"

To this, however, it is only fair to add the statement of Mr. Leonard Huxley that his father,

“ . . . would not have used the Bible as the agency for introducing the religious and ethical idea into education if he had been dealing with a fresh and untouched population ” (Life, i, p. 343).

Of course not, for adaptation to existing environments is in the essence of all progress.

As a member of the London School Board, Huxley did his best to carry into effect the views just explained, supporting, for example, a resolution proposed by Mr. W. H. Smith, M.P., and carried by a large majority, to the effect :—

“ That, in the schools provided by the Board, the Bible shall be read, and there shall be given therefrom such explanations and such instruction in the principles of religion and morality as are suited to the capacities of children.”

Unfortunately ill health necessitated resignation of his seat on the Board in the early part of 1872, though even during the brief space of fourteen months for which he served he had succeeded in realizing some part of his

ideals as to elementary education. As was to be expected, Huxley made a deep impression upon his fellow-members, many of whom had felt no small dismay at his election. Such fears were soon dispelled by his straightforward honesty, consideration for the opinions of others, and strong common sense. And there can be no doubt that his resignation was accepted with very real regret. Our debt to him in respect of elementary education, and the personal impression he made on the School Board, will be fully realized by reading the contributions furnished by Dr. J. H. Gladstone to Mr. Leonard Huxley for biographical purposes (*Life*, i, pp. 349-50). The essence of the matter is contained in the following brief extracts from this contribution :—

“On February 7 [1872], a letter of resignation was received from him. . . . The Rev. Dr. Rigg, Canon Miller, Mr. Charles Read, and Lord Lawrence [the Chairman] expressed their deep regret. In the words of Dr. Rigg, ‘they were losing one of the most valuable members of the Board, not only because of his intellect and trained acuteness, but because of his knowledge of every subject connected with culture and education, and because of his great fairness and impartiality with regard to all subjects that came under his observation.’ Though Huxley quitted the Board after only fourteen months’ service, the memory of his words and acts combined to influence it long afterwards. . . . It was our duty to put into practice the scheme of instruction which Huxley was mainly instrumental in settling. . . . Kindergarten methods have been promoted. Drawing, on which Huxley laid more stress than his colleagues generally did, has been enormously extended and greatly revolutionized in its methods. Object lessons and elementary science have been introduced everywhere, while shorthand, the use of tools for boys, and cookery and domestic economy for girls, are becoming essentials in our schools. Evening continuation schools have lately been widely extended. Thus the impulse given by Huxley in the first months of the Board’s existence has been carried forward by others, and is now affecting the minds of the half million of boys and girls in the

Board Schools of London, and indirectly the still greater number in other schools throughout the land."

Huxley's influence endures to-day not merely in the general character of elementary instruction, but also in the easily available means by which pupils of ability are enabled to take advantage of higher education. Indeed, the "educational ladder" is perhaps set at too easy an angle.

Baseless assertions were made at the time that Huxley was led by personal ambition to become a member of the School Board, and that he contemplated a political career. As a matter of fact the opportunity was more than once afforded him of offering himself as a candidate to a parliamentary constituency, and in the opinion of those most competent to judge, *e.g.*, Sir Mountstuart Grant Duff (*Life*, i, pp. 354-5), he would have proved a brilliant success in the House of Commons, provided the strain had not proved too much for his physical endurance.

For the sake of continuity Huxley's School Board work has been taken as a whole, and it will now be necessary to go back to 1870 for the purpose of considering other events and other kinds of activity. The publication of *Lay Sermons, Addresses and Reviews* during this year, largely extended his influence as an educationist, and met with a large and increasing popularity. A volume of selections from it was published during the following year.

An address "On Medical Education" (*Coll. Essays*, iii, p. 303), given during 1870 to the medical students of University College, London, contains some very interesting suggestions, some of which might still be carried out with advantage, despite the many advances which have been made during the last thirty-five years. The

importance to medical students of some school training in chemistry, physics and botany is emphasized, some criticism is directed against the current methods of teaching and acquiring a knowledge of physiology, and the abolition of comparative anatomy and materia medica from the medical curriculum advocated. Besides this it is strongly urged that, in the interest of the London medical schools, the teaching of the theoretical subjects in the course of study ought to be centralized in two or three institutions.

One of Huxley's most famous addresses, that "On Descartes' 'Discourse touching the Method of using one's Reason rightly and of seeking Scientific Truth,'" was delivered on March 24, to the Cambridge Y.M.C.A. (Coll. Essays, i, p. 166). The address is not merely interesting as a lucid exposition of Cartesian philosophy, but also because it demonstrates that this philosophy was one of the important influences that had helped to bring about Huxley's characteristic intellectual attitude:—

"This golden rule is—give unqualified assent to no propositions but those the truth of which is so clear and distinct that they cannot be doubted. The enunciation of this great first commandment of science consecrated Doubt. It removed Doubt from the seat of penance among the grievous sins to which it had long been condemned, and enthroned it in that high place among the primary duties, which is assigned to it by the scientific conscience of these latter days. . . . When I say that Descartes consecrated doubt, you must remember that it was that sort of doubt which Goethe has called, 'the active scepticism, whose whole aim is to conquer itself;' and not that other sort, which is born of flippancy and ignorance, and whose aim is only to perpetuate itself, as an excuse for idleness and indifference."

Another very well-known lecture, "On the Formation

of Coal" (Coll. Essays, viii, p. 137), was delivered at the Philosophical Institute, Bradford, and much resembles in character the one "On a Piece of Chalk," given two years previously (*cf.* p. 87).

The following are the scientific memoirs and more technical addresses of 1870:—

1. "Anniversary Address of the President" (Q. J. Geol. Soc., xxvi, 1870, pp. xxix-lxiv. Delivered February 18, 1870. Sci. Mem., iii, xxx, p. 510. Reprinted under the title of "Palæontology and the Doctrine of Evolution," in Coll. Essays, viii, p. 340).—The more important of the deceased Fellows to whom tributes were paid are the Vicomte d'Archiac, J. Beete Jukes, H. C. E. von Meyer and J. W. Salter. The address may be described as bringing a previous one up to date. In memoirs already dealt with (*cf.* pp. 89, 95) Huxley had pointed to certain extinct reptiles (Ornithoscelida, a group of Dinosauria) as being the animals most nearly intermediate between reptiles and birds. Here he adds:—

"... it is very doubtful whether any of the genera of Ornithoscelida with which we are at present acquainted, are the actual linear types by which the transition from the lizard to the bird was effected. These, very probably, are still hidden from us in the older formations."

This view has been amply endorsed by subsequent research. We have also the famous account of the pedigree of the horse, so far as then known. Existing equine quadrupeds, with their one-toed extremities (possessing, however, in the "splint-bones," vestiges or rudiments of two others), and complex grinding teeth, are traced back to earlier three-toed forms (Hipparion, Anchitherium, Plagiolophus), in which the teeth in question are simpler in character. And in connection

with this comes the famous prophecy now completely fulfilled:—

“If the expectation raised by the splints of the horses that, in some ancestor of the horses, these splints would be found to be complete digits, has been verified, we are furnished with very strong reasons for looking for a no less complete verification of the expectation that the three-toed *Plagiolophus*-like ‘*avus*’ of the horse must have had a five-toed ‘*atavus*’ at some earlier period.”

2. “On the Milk Dentition of *Palæotherium magnum*” [an extinct mammal related to the elephants] (*Geol. Mag.*, vii, 1870, pp. 153-5. *Sci. Mem.*, iii, xxxv, p. 595).

3. “Triassic Dinosauria” (*Nature*, i, 1870, pp. 23-4. *Sci. Mem.*, iii, xxxvi, p. 599).

4. “On the Ethnology of Britain” (*J. Ethnol. Soc.*, New Series, ii, 1870, pp. 382-4. Read May 10, 1870. *Sci. Mem.*, iii, xxxi, p. 551). Afterwards published in the *Contemporary Review* under the title of “Some Fixed Points in British Ethnology” (*Coll. Essays*, vii, p. 253).

5. “Anniversary Address of the President” (*op. cit.*, pp. xvi-xxiv. Delivered May 24, 1870. *Sci. Mem.*, iii, xxxii, p. 554).—We gather from this that Huxley was trying to bring about an amalgamation between the Ethnological and Anthropological Societies, the aims of which were practically the same.

His views as to the racial nature of the inhabitants of the west of England appear to have given offence to an individual who attacked him in the *Pall Mall Gazette*, under the *nom de plume* of “A Devonshire Man,” and unwisely launched into personalities, which elicited the following withering retort:—

“‘A Devonshire man’ is good enough to say of me that ‘cutting up monkeys is his forte, and cutting up men is his

foible.' With your permission, I propose to cut up 'A Devonshire Man'; but I leave it to the public to judge whether, when so employed, my occupation is to be referred to the former or to the latter category" (*Life*, i. pp. 325-6).

6. "On the Geographical Distribution of the Chief Modification of Mankind" (*op. cit.*, pp. 404-12. Read June 7, 1870. *Sci. Mem*, iii, xxxiii, p. 564).

7. "Presidential Address to the British Association at Liverpool" (*Rep. Brit. Assoc.* (1870), 1871, pp. lxxiii-lxxxix. *Sci. Mem.*, iii, xxxiv, p. 572. *Coll. Essays*, viii, p. 229).—This deals with "Biogenesis and Abiogenesis," the origin of life from life, as against "spontaneous generation," or conversion of non-living matter into living. After a sketch of the history of the question, showing how abiogenesis had gradually been disproved for the more obvious organisms, an account is given of the way in which Pasteur and others disproved it for bacteria, the last stronghold of the spontaneous generationists. Huxley himself repeated these experiments, and some of the flasks of sterilized hay-infusion he employed long afterwards figured on his lecture bench.

But while the address clearly sets forth the disproof of all supposed cases of abiogenesis so far as the present is concerned, it proceeds to the logical conclusion that as an "act of philosophic faith" it is necessary to believe that the first living matter was so formed. It is suggested that the earliest organisms must have been independent of light, feeding in much the same way as fungi do now. This last view has not found general acceptance.

Prominence is given to the practical bearing of researches on bacteria, and other lower forms, on the treatment of contagious and infectious diseases, whether of human beings, animals or plants. The pioneer work of Pasteur on the silkworm disease known as pébrine is

quoted, and scarlet fever is spoken of as a disease that will ultimately be stamped out :—

“ And thus mankind will have one more admonition that ‘ the people perish for lack of knowledge ; ’ and that the alleviation of the miseries, and the promotion of the welfare, of man must be sought, by those who will not lose their pains, in that diligent, patient, loving study of all the multitudinous aspects of Nature, the result of which constitute exact knowledge, or Science.”

8. “ On the Relations of Penicillium, Torula, and Bacterium ” (Address to the Biological Section of the Brit. Assoc., September 13, 1870. Report by E. Ray Lankester in the Q. J. Micros. Sci. New Series, x, 1870, pp. 355-62. Sci. Mem., iii, xxxvii, p. 601).—Here are detailed some of the results of investigations on certain lower forms of plant life (compare 7). Huxley’s attention was directed to these forms, partly from a desire to get first-hand knowledge of types he intended to include in a course on practical biology, and partly by the researches of Dr. Bastian, in which bacteria were asserted to have been spontaneously generated.

1871.

The School Board work of 1871, which has already been dealt with, naturally limited activity in other directions, though there is still plenty to record. The most important event of the year was perhaps Huxley’s acceptance of the Secretaryship of the Royal Society, which arduous post he held for the next ten years. Among the most important duties discharged during this period were those in connection with the *Challenger* committee.

We find the usual variety of lectures delivered to all sort of audiences, and embracing a wide range of topics. The one on “ Administrative Nihilism ” (Coll. Essays, i,

p. 251), given at the Midland Institute, Birmingham, on October 9, is of special interest, for it gives an account of the educational policy which Huxley had so strenuously urged upon the London School Board. It includes a defence of educational progress for the benefit of the masses, and recognizes that training of the intellect is not the only thing at which to aim :—

“Thoughtfulness for others, generosity, modesty, and self-respect, are the qualities which make a real gentleman or lady, as distinguished from the veneered article, which commonly goes by that name.”

Locke’s definition, “The end of Government is the good of mankind,” is accepted, and the conclusion reached that the Government is justified in undertaking to educate the people.

Discourses at the Royal Institution (May 12 and 19) entitled “Berkeley on Vision,” and “Metaphysics of Sensation” (Coll. Essays, vi, 243) would seem to have been suggested by the recent appearance of Fraser’s edition of Berkeley’s works.

The most important lecture development of the year, however, consisted in a summer course for teachers on Biology, *with practical work*, an entirely new departure. In this course he was assisted by E. Ray Lankester. It is relevant to mention here that from 1870 to 1875, Huxley was a member of a Royal Commission on Scientific Instruction and the Advancement of Science.

An essay on “Yeast” (Sci. Mem., iii, xxxviii, p. 608. Coll. Essays, viii, p. 110), published in the *Contemporary Review* for December, is a part of the work on lower forms of life, to which Huxley had been devoting much attention (*cf.* pp. 109-10). It gives a very interesting historical account of the growth of our knowledge in regard to alcoholic fermentation. A quotation is given from

Schwann (*Mikroskopische Untersuchungen*) embodying a view of this pioneer worker to the effect,

“ . . . that every cell of the living body exerts an influence on the matter which surrounds and permeates it, analogous to that which the *Torula* [*i.e.* yeast plant] exerts on the saccharine solution by which it is bathed. A wonderfully suggestive thought, opening up views of the nature of the chemical processes of the living body, which have hardly yet received all the development of which they are capable.”

The doctrine of “internal secretions” would appear to be the modern expression of this epoch-making idea. The essay also dwells on the importance of the “germ theory,” with regard to infectious and contagious disease.

An important article, entitled “Mr. Darwin’s Critics,” was contributed to the *Contemporary Review* for November (Coll. Essays, ii, p. 120). This deals with Wallace’s *Contributions to the Theory of Natural Selection*, Mivart’s *Genesis of Species*, and a *Quarterly Review* notice of Darwin’s *Descent of Man*. Wallace denied that man could have been evolved by natural selection, while Mivart admitted its possibility for the bodily frame. The *Quarterly* reviewer was long afterwards publicly admitted to have been Bishop Wilberforce.

Huxley’s essay follows Darwinism to its logical conclusion, and adopts the view that there has been a gradual evolution of mind. Mivart asserted the teachings of orthodox Catholic authorities to be evolutionary, citing more particularly the Jesuit writer, Father Suarez. Huxley definitely disproves this, for the authority in question. Writing to Darwin on this point, he says (Life, i, p. 364):—

“So I have come out in the new character of a defender of Catholic orthodoxy, and upset Mivart out of the mouth of his own prophet.”

The estimate of Huxley's mental powers formed by some of his friends is strikingly embodied in a remark Darwin, when expressing his appreciation of "Mr. Darwin's Critics," quotes from Hooker :

"When I read Huxley, I feel quite infantile in intellect (Life, i, p. 365).

The preparation of this defence of Darwin, and of the article on "Administrative Nihilism" took up no small part of the brief summer holiday at St. Andrews, which was also trenched upon by the British Association (Edinburgh Meeting) and other activities. Attempts, none too successful, at golf-playing, did not sufficiently compensate for over-pressure during the vacation, and a break-down in health took place at the end of the year.

Mention must also be made of the *Manual of the Anatomy of Vertebrated Animals*, which appeared in 1871, and though never revised, is still (thirty-five years later) indispensable to the student of vertebrate anatomy. It differs profoundly from average text-books in that most of the contained matter is based either on the author's own researches or his first-hand observation of facts.

This year, too, Huxley, Roscoe, and Balfour Stewart undertook the joint editorship of a series of *Science Primers* for Messrs. Macmillan.

CHAPTER XII

EGYPT—LORD RECTOR OF ABERDEEN UNIVERSITY—
PRACTICAL BIOLOGY [1872-75].

A CONSIDERABLE part of 1872 was necessarily spent in the pursuit of health, for overwork and a variety of worries, including financial ones, had led to a recurrence of the old malady, dyspepsia, and a complete break-down resulted. The necessary means for meeting the expenses of a complete rest abroad were subscribed by eighteen friends, and Huxley was apprised by an affectionate and most delicately-worded letter from Darwin (Life, i, p. 366), that his banking account had been credited with the sum of 2000 guineas.

On January 11, he left Southampton for Egypt, visiting Gibraltar on the way, partly for the purpose of investigating, on behalf of the Admiralty, the infestation of stored biscuits by the grubs of a small beetle (*Ephestia elatella*). The source of infection was discovered, and a term put to the insects' ravages. On February 1, Huxley reached Alexandria, and went up the Nile as far as Assouan. Of the effect of Egypt upon his mind, Mr. Leonard Huxley thus speaks (Life, i, pp. 369-70):—

“Egypt left a profound impression upon him. His artistic delight in it apart, the antiquities and geology of the country were a vivid illustration to his trained eye of the history of man and the influence upon him of the surrounding country, the link between geography and history.”

Returning from Egypt by way of Italy, Catania, Naples, Pozzuoli, Pompeii, and Rome were visited, and

an ascent made of Vesuvius. London was reached on April 6. Unfortunately the rest and change were of little permanent benefit.

During this year Huxley's department migrated from Jermyn Street to South Kensington, and, for the first time, he was able to give his ordinary students the benefit of practical instruction, on the same lines as those adopted for the summer class in 1871. Speaking of the method employed, Mr. Leonard Huxley says (*Life*, i, p. 376):—

“It involved the verification of every fact by each student, and was a training in scientific method even more than in scientific fact.”

This may have been the aim of the work, but if “every fact” means all or most of those given in the lectures, the statement is very far from being correct. Every teacher of botany or zoology is fully aware that only a selection of leading facts can be verified by elementary students.

But, even so, the advance on current methods was a great one, and unanticipated in Britain, except by Rolleston at Oxford, and he, according to Professor Ray Lankester, had been influenced by Huxley's advice, and fortunately had “the earlier opportunity of putting the method into practice.” The courses thus initiated were on the “type system,” a series of average organisms being examined and dissected to illustrate the groups to which they belong. This method has profoundly influenced the teaching of Biology in this country, and fully justified Huxley's expectation that it would “grow into a big thing and bear great fruit.” Of late, however, the system has been somewhat discredited, since the practice of a number of teachers, following the arbitrary require-

ments of various examiners, has been to make the subject a weary grind of disconnected facts, many of them of exceedingly trivial kind. For some years the extraction of the minute ovaries of the earthworm was the goal of the student of elementary Biology. Although the "pious founder" must not be blamed for the way in which his method has been perverted, yet he was accustomed to enter into somewhat full detail regarding the anatomy and physiology of the rabbit, thus limiting the time available for the other types, and creating a wrong impression among the unintelligent.

Huxley's classes at South Kensington were made up of two varieties of student, those who paid, and those who were paid for by the Government, *i.e.*, science teachers in training. The latter were by many regarded as of an inferior order, and had to attend every Saturday to receive their weekly allowance of twenty-five shillings (since reduced in amount) from the hands of a petty official, factory fashion. Some of the professors even put up two examination lists, thus emphasizing the gulf dividing the two castes. Opposed as he always was to snobbery in every form, Huxley made no such invidious distinction, and the names of sheep and goats alike were associated in the same list.

It has elsewhere been mentioned (*cf.* pp. 56, 77), that Huxley sympathized with the movement for the higher education of women, and anticipated no ill effects from placing every facility in their way, but an incident of this year (1872) shows that he was opposed to "mixed" classes in certain subjects. Miss Jex Blake, who was furthering the cause of women medical students at Edinburgh, had asked him to examine their male demonstrator in anatomy, with a view to his recognition by the University Court.

In a letter giving good reasons for declining to accede to this request, he expresses his sympathy with the aspirations of women in the direction of medicine, but adds :—

“I as completely sympathize with those Professors of Anatomy, Physiology, and Obstetrics, who object to teach such subjects to mixed classes of young men and women brought together without any further evidence of moral and mental fitness for such association than the payment of their fees. In fact, with rare exceptions, I have refused to admit women to my own lectures on Comparative Anatomy for many years past. But I should not hesitate to teach anything I know to a class composed of women. . .” (Life, i, p. 387).

It greatly redounds to the credit of Scotland that Huxley was very early recognized and appreciated there. Of the four honorary doctorates conferred on him by British Universities, the order was—Edinburgh, 1866; Dublin, 1878; Cambridge, 1879; Oxford, 1885. In 1872, the students of Aberdeen elected him Lord Rector of their University. His address in that capacity was delivered in 1874, and will be dealt with later.

The only scientific memoir that appeared in 1872 was in completion of his monumental work on fossil fishes, “British Fossils. Illustrations of the Structure of Cross-opterygian Ganoids” (Mem. Geol. Survey, U.K., Decade XIII, 1872; Sci. Mem., Supply. Vol., III, p. 68). It deals with *Holophagus gulo*.

1873.

In 1873 Huxley's health was fortunately pretty well established, largely as a result of a summer holiday spent in the Auvergne district. This included not only exercise and change of scene, but also change of work in the

form of geological and archæological observations, and a careful study of literature for and against the pseudo-miracles of Lourdes. His travelling companion was Hooker. One outcome of the holiday was the publication by the latter of observations on glaciation in central France (*Nature*, xiii, p. 31), though it afterwards turned out that the results had been anticipated by others. The trip ended in Switzerland and South Germany.

Those who crave for personal details will be interested to know that during this tour Huxley consumed a reasonable number of cigars. Hooker had previously (1867) introduced him to cigarettes, as an antidote for gastric disturbance. A somewhat ardent devotion to "my Lady Nicotine" ultimately culminated in the pipe (1875). The practice, however, was primarily therapeutic, for Hooker says (*Life*, i, p. 393, foot-note):—

"I have never blamed myself for the 'teaching him' to smoke, for the practice habitually palliated his distressing symptoms when nothing else did, nor can his chronic illness be attributed to the abuse of tobacco."

The present writer, however, does not propose to promote the sale of one or more brands, by mentioning them here.

Among other fresh duties undertaken were those connected with his appointment as a Governor of Owens College, which institution was opened in the autumn. Much time was taken up in connection with the Royal Commission on Scientific Instruction, etc.

Some of Huxley's essays were collected and published this year under the title of *Critiques and Addresses*. Though very largely read this never attained the extreme popularity of *Lay Sermons* (*cf.* p. 105). An essay entitled "Problems of the Deep Sea" was put out in 1873

(Coll. Essays, viii, p. 37). It explained the aims of the *Challenger* expedition, which had started on December 21, 1872, and gave a popular account of the various kinds of apparatus employed. As a member of the *Challenger* Committee of the Royal Society, Huxley had had a great deal to do both with arranging the programme of the expedition, and laying down the methods to be employed.

1874.

With health fairly well re-established, the work accomplished during 1874 was of increased amount. The most important event that took place in the early part of the year was the Rectorial Address on "Universities: Actual and Ideal," given at Aberdeen (Coll. Essays, iii, p. 189).—This compares to their disadvantage —

"... the host of pleasant, moneyed, well-bred young gentlemen, who do a little learning and much boating by Cam and Isis," with "many a brave and frugal Scotch boy, spending his summer in hard manual labour, that he may have the privilege of wending his way in autumn to this University, with a bag of oatmeal, ten pounds in his pocket, and his own stout heart to depend upon through the northern winter."

The contrast is perhaps a little overdone, and reminds one of the more recent utterance of a well-known nobleman, who described a newly-established University as adapted to "the hard and even horny-handed workman," at the first meeting of the Court of that University.

The address describes the ideal University as one in which all subjects of study are impartially treated, and as to the student:—

"... the very air he breathes should be charged with that enthusiasm for truth, that fanaticism of veracity, which is a

greater possession than much learning; a nobler gift than the power of increasing knowledge; by so much greater and nobler than these, as the moral nature of man is greater than the intellectual; for veracity is the heart of morality."

Then follows a plea for art and a scheme for the improvement of medical education. It is suggested that the two first years be given to Anatomy, Physiology, Physiological Chemistry and Physics; the fundamental principles of Chemistry, Physics, and Biology having been previously acquired. Huxley notes with satisfaction the inclusion of Zoology as a compulsory subject in the Arts course in Aberdeen. This, however, is not now the case. The Address further advocates the establishment of a Faculty of Science in every University, sets forth the claims of research, touches on the question of examinations, and points out the necessity for properly organized secondary education.

It is gratifying to find that Huxley was able, at Aberdeen, to do something towards bringing about the reforms in medical education which he advocated in his Rectorial Address.

The second important address of the year (August 2), was upon "Joseph Priestley" (Coll. Essays, iii, p. 1), given on the occasion of the presentation of a statue of Priestley to the town of Birmingham by Lord Derby. He speaks of Priestley as one of the men whose work helped to bring about the expansion of science, and the scientific spirit, which mark the nineteenth, as compared with the eighteenth, century:—

"If we ask what is the deeper meaning of all these vast changes, I think there can be but one reply. They meant that reason has asserted and exercised her primacy over all provinces of human activity: that ecclesiastical authority has been relegated to its proper place; that the good of the governed has been

finally recognized as the end of government, and the complete responsibility of governors to the people as its means; and that the dependence of natural phenomena in general on the laws of action of what we call matter has become an axiom."

The British Association was held at Belfast this year, and on August 24 Huxley delivered an address "On the Hypothesis that Animals are Automata, and its History" (Coll. Essays, i, p. 199). This demonstrates that the foundations of neuro-physiology were laid down by Descartes, though the position that brutes are unconscious machines is discarded as untenable. It is worth noting that in this essay Huxley categorically denies the charges of fatalism, materialism, and atheism, made at various times against himself.

The views upon women's medical education, alluded to in connection with Miss Jex Blake's letter of the previous year, were further elaborated and expressed in 1874. This lady had failed in the Edinburgh examinations, and Huxley pronounced adversely upon her papers when these were referred to him for report. The following extract from the *Times* for July 8, 1874, clearly explains his position:—

"As Miss Jex Blake may possibly think that my decision was influenced by prejudice against her cause, allow me to add that such prejudice as I labour under lies in the opposite direction. Without seeing any reason to believe that women are, on the average, so strong physically, intellectually, or morally, as men, I cannot shut my eyes to the fact that many women are much better endowed in all these respects than many men, and I am at a loss to understand on what grounds of justice or public policy a career which is open to the weakest and most foolish of the male sex should be forcibly closed to women of capacity.

"We have heard a great deal lately about the physical disabilities of women. Some of these alleged impediments, no doubt, are really inherent in their organization, but nine-tenths of them are artificial—the products of their modes of life. I

believe that nothing would tend so effectually to get rid of these creations of idleness, weariness, and that 'over-stimulation of the emotions,' which, in plainer-spoken days, used to be called wantonness, than a fair share of healthy work, directed towards a definite object, combined with an equally fair share of healthy play, during the years of adolescence; and those who are best acquainted with the requirements of an average medical practitioner will find it hardest to believe that the attempt to reach that standard is like to prove exhausting to an ordinarily intelligent and well-educated young woman."

One curious piece of work done in 1874 was the writing of a report (dated January 27) on a spiritualistic *séance* attended, the conclusion being reached that this was an unmitigated fraud. He had investigated the subject in previous years.

For some time Huxley, in conjunction with W. K. Parker, had been busily engaged in working at the structure of the skull, a subject in which he had long been interested (*cf.* p. 40). The following scientific memoirs of 1874 were mostly on this subject.

1. "On the Structure of the Skull and of the Heart of *Menobranchus lateralis*" (Proc. Zool. Soc., 1874, pp. 186-204. Read March 17, 1874. Sci. Mem., iv, 1, p. 1).

2. "Note on the Development of the Columella Auris in the Amphibia (Nature, xi, 1875, pp. 68-9. Read at the Brit. Assoc., Belfast, August 25, 1874. Sci. Mem., iv, II, p. 23).

3. "Preliminary Note upon the Brain and Skull of *Amphioxus lanceolatus*" (Proc. Roy. Soc., xxiii, 1875, pp. 127-32. Received December 17, 1874. Sci. Mem., iv, III, p. 26).

4. "On the Bearing of the Distribution of the Portio Dura upon the Morphology of the Skull" (Proc. Phil. Soc., Cambridge, ii, 1876, pp. 348-51. Read May 11, 1874. Sci. Mem., iv, IV, p. 32).

5. "On the Classification of the Animal Kingdom" (J. Linn. Soc. (Zool.), xii, 1876, pp. 199-226. Read December 3, 1874. Sci. Mem., iv. v, p. 35).

Huxley advised Professor Baynes, the general editor of the *Encyclopædia Britannica*, about the apportionment of the biological articles to be included in the ninth edition, and himself wrote up Actinozoa, Amphibia, Animal Kingdom, Biology, and Evolution. The preparation of these articles began late in 1873 and went on intermittently till 1878, when that on Evolution was completed.

After recommending a particular specialist as suitable for the task of writing an important article, Huxley adds,—

"... if it had not been for the accident of being a procrastinating, impracticable ass, he could have been a distinguished man. But he is a sort of Balaam-Centaur, with the asinine stronger than the prophetic moiety" (Life, i, p. 452).

The current system of supporting applications by means of testimonials would certainly be abandoned if all such documents were frankly conceived and epigrammatically written in this style.

1875

The earliest important event of 1875 was the delivery of an address at the Royal Institution on January 29, the subject being "On the Recent Work of the *Challenger* Expedition, and its bearing on Geological Problems" (Proc. Roy. Inst., vii, 1875, pp. 354-7. Sci. Mem., iv, vi, p. 61. Coll. Essays, viii, p. 69).—This gives an account of the various deposits accumulating on the sea-floor, and seeks to explain the unfossiliferous nature

of some geological strata by comparing them with the red clays characteristic of the deepest parts of the oceans.

The absence of Prof. Wyville Thomson as chief naturalist to the *Challenger* expedition necessitated the appointment of deputies to carry on the work of his Edinburgh classes. For the summer session of 1875 Huxley's services were secured, and he managed to review the entire animal kingdom in fifty-four lectures (May 3 to July 23), given to a record class of 353 students. In a letter to Tyndall (dated August 13, 1875) he says :—

“My work at Edinburgh got itself done very satisfactorily, and I cleared about £1000 by the transaction, being one of the few examples known of a Southern coming north and pillaging the Scots” (Life, i, p. 447).

In the *Life* (pp. 36-7) of one of the pupils attending this particular class, the late Joseph Thomson, the following interesting impressions of Huxley as a teacher are given :—

“The experience of studying personally under Huxley was a privilege to which he had been looking forward with eager anticipation ; for he had already been fascinated with the charm of Huxley's writings, and had received from them no small amount of mental stimulus. Nor were his expectations disappointed. But he found the work to be unexpectedly hard, and very soon he had the sense of panting to keep pace with the demands of the lecturer. It was not merely that the texture of scientific reasoning in the lectures was so closely knit,—although that was a very palpable fact—but the character of Huxley's terminology was entirely strange to him. It met him on his weakest side, for it presupposed a knowledge of Greek (being little else than Greek compounds with English terminations), and of Greek he had none.

“‘Huxley's usual lectures,’ he writes, ‘are something awful to listen to. One half of the class, which numbers about four hundred, have given up in despair from sheer inability to follow

him. The strain on the attention of each lecture is so great as to be equal to an ordinary day's work. I feel quite exhausted after them. And then to master his language is something dreadful. But, with all these drawbacks, I would not miss them, even if they were ten times as difficult. They are something glorious, sublime. . . . Huxley is still very difficult to follow, and I have been four times in his lectures completely stuck and utterly helpless. But he has given us eight or nine beautiful lectures on the frog.'”

For comparison with the above, the writer can only offer his personal experience of one course of regular lectures (1879-80). These were perhaps less compressed than those given in Edinburgh, and in any case were perfectly easy to follow, though to reap full benefit from them a good deal of previous reading was necessary. Note-taking, however, was an exceedingly difficult matter, even in shorthand, owing to Huxley's great fluency and his habit of illustrating the subject by means of rapid blackboard sketches, without ceasing to speak. Such terms as “glorious” and “sublime” are somewhat out of place. “Lucid” and “incisive” would be nearer the mark. No particular knowledge of Greek was necessary in 1879, whatever may have been the case in 1875.

For some years the anti-vivisectionists had been making their voices heard both in and out of season. Huxley among others had quite undeservedly earned the reputation of being perfectly callous to the sufferings of animals employed for physiological experiment. As a matter of fact he was extremely tender-hearted where animals were concerned, and expressly refrained from entering upon investigations involving vivisection. But this was a very different matter from denying the necessity for expert research in directions where the benefit of mankind was involved.

During 1875 the vivisection controversy culminated in the appointment of a "Royal Commission on the Practice of subjecting Live Animals to Experiments for Scientific Purposes." In writing to the then Home Secretary (Mr. Cross) to express his willingness to serve, Huxley sufficiently defines his position in the matter:—

"If I can be of any service I shall be very glad to act on the Commission, sympathising as I do on the one hand with those who abhor cruelty to animals, and, on the other, with those who abhor the still greater cruelty to man which is involved in any attempt to arrest the progress of physiology and of rational medicine" (Life, i, p. 439).

The report of the Commission, presented in the early part of 1876, was decidedly unsatisfactory, and the legislation which followed upon it was still more so.

In 1875 the first edition appeared of *A Course of Practical Instruction in Elementary Biology*, in the preparation of which the late Dr. H. N. Martin collaborated. Up to this time the only practical book available to the student was Rolleston's *Forms of Animal Life*, which was not only expensive but of limited use for laboratory purposes, since it merely described the Oxford series of dissections, and gave no practical directions at all. "Huxley and Martin" was largely used for many years, and did yeoman service in advancing the cause of practical biology. Owing largely to its employment, the "type system" became firmly established as the recognized method of teaching biology in this country. Unfortunately, in course of time, it underwent a curious perversion, due to unintelligent teaching and still more unintelligent examining. A mass of minute detail gradually became associated with the chosen types, the acquisition of which prevented average students from grasping

fundamental principles. A concrete instance of "not seeing the wood for the trees."

The three following scientific memoirs represent part of the work done during 1875, though the two last were not published till the following year :—

1. "On *Stagonolepis Robertsoni*, and on the Evolution of the Crocodilia" (Q. J. Geol. Soc., xxxi, 1875, pp. 423-38. Sci. Mem., iv, vii, p. 66).—This famous memoir propounds an evolutionary classification of crocodilian reptiles, including the ancient extinct type named. The hinder openings of the nasal cavities are placed far back in the throat in recent crocodiles, and so disposed that the mouth can be kept open under water without danger of suffocation, an obvious adaptation to the aquatic habit. The way in which this arrangement has gradually evolved is here set forth.

2. "Contributions to Morphology. Ichthyopsida. No. 1. On *Ceratodus Forsteri*, with Observations on the Classification of Fishes" (Proc. Zool. Soc., 1876, pp. 24-59. Received January 4, 1875. Sci. Mem., iv, viii, p. 84).—The form in question is the Australian Lung-fish, one of the few surviving members of a once widely distributed and dominant marine group, which have been saved from extinction by taking to a life in fresh water, where the struggle for existence is less severe. The classificatory part of the memoir, largely based on the characters of the skull and fins, is distinctly of epoch-making character, and has had to be reckoned with in all subsequent attempts to place the systematics of fishes on a sound footing.

3. "On the Position of the Anterior Nasal Apertures in *Lepidosiren*" (op. cit., pp. 180-1. Received January 7, 1876. Sci. Mem., iv, ix, p. 125).—This is a note on the South American Lung-fish.

CHAPTER XIII

VISIT TO AMERICA [1876-77].

ONE of the earlier efforts of 1876 was a Friday Evening Discourse, delivered on January 28, at the Royal Institution "On the Border Territory between the Animal and the Vegetable Kingdoms," afterwards published in *Macmillan's Magazine* (Sci. Mem., iv, xi, p. 145. Coll. Essays, viii, p. 162). Here the conclusion is reached that,—

"the difference between animal and plant is one of degree rather than kind, and that the problem whether, in a given case, an organism is an animal or a plant, may be essentially insoluble."

A second lecture "On the Teleology and Morphology of the Hand," given at Glasgow on February 15, was never published in its original form, but is of special interest because it emphasizes the Darwinian doctrine that teleology and evolution are so far from being irreconcilable that the former, broadly expressed, is a necessary corollary of the latter. The old teleology, as more particularly set forth in Paley's *Natural Theology* (one of Huxley's favourite Sunday books as a boy), held that every organism and organ was separately created for a special purpose, finding this the only explanation of the adaptation of structure to function everywhere to be found. Bell's famous *Bridgewater Treatise* on the human hand develops this view with reference to a particular instance, and no doubt suggested to Huxley his choice of subject for the Glasgow lecture.

The new teleology explains the adaptation of structure

to function as the result of evolution, and renders intelligible many things, such as vestigial organs and imperfect adaptations, which were simply ignored by its forerunner. While not demanding a theistic standpoint, it is not inconsistent with this.

As in the previous year a course of lectures was given at Edinburgh during the Summer Session, and one or two incidents relating to this time deserve notice. In a home letter (dated May 8, *Life*, i, p. 458), we find a list of the light and other literature taken North as a set-off against work, and note that, unlike Darwin, Huxley retained an interest in fiction :—

“ I have been getting through an enormous quantity of reading, some tough monographs that I brought with me, the first volume of Forster's *Life of Swift*, *Goodsir's Life*, and a couple of novels of George Sand, with a trifle of Paul Heyse. You should read George Sand's *Césarine Dietrich* and *La Mare au Diable* that I have just finished. She is bigger than George Eliot, more flexible, a more thorough artist. It is a queer thing by the way, that I have never read *Consuelo*. I shall get it here. When I come back from my lecture I like to rest for an hour or two over a good story. It freshens me wonderfully.”

It would have been decidedly entertaining to see Huxley on May 25, sitting beside the Lord High Commissioner at the General Assembly. His report of the proceedings is a model of brevity :—

“ . . . I heard an ecclesiastical row about whether a certain church should be allowed to have a cover with IHS on the Communion Table or not. After three hours' discussion the IHSers were beaten ” (*Life*, i, p. 458).

The social side of the temporary residence in Edinburgh at this time left many pleasant memories, especially of the numerous visits to Dr. (afterwards Sir John) Skelton at

the Hermitage of Braid, which laid the foundation of a warm and long friendship.

The great event of 1876 was the American visit, Huxley's "second honeymoon," in the course of which he once more met (after a separation of thirty years), his favourite sister Lizzie (Mrs. Scott), whose love and encouragement had done so much for him in early years. The occasion of the visit was the delivery of the opening address at the Johns Hopkins University in Baltimore.

New York was reached on August 5, and two characteristic remarks made on first sight of the city have been recorded by Mr. Smalley (London correspondent of the *New York Tribune*). In response to a question as to the names of two buildings:—

"I told him the *Tribune* and the Western Union Telegraph buildings. 'Ah,' he said, 'that is interesting; that is American. In the Old World the first things you see as you approach a great city are steeples; here you see, first, centres of intelligence.' Next to those the tug-boats seemed to attract him as they tore fiercely up and down and across the bay. He looked long at them and finally said, 'If I were not a man I think I should like to be a tug.' They seemed to him the condensation and complete expression of the energy and force in which he delighted (*Life*, i, p. 461).

Huxley was naturally intensely interested in Prof. Marsh's collection of fossils from the wonderfully rich strata of the Western Territories, which demonstrated the American origin of the horse, and proved of the first importance in placing the doctrine of evolution on a firm palæontological basis. The geological history of the horse was to be the subject of one of the New York lectures, and the study of the Yale specimens necessitated important alterations in what had been written for this purpose. Marsh thus describes Huxley's attitude in the matter:—

“He then informed me that all was new to him, and that my facts demonstrated the evolution of the horse beyond question, and for the first time indicated the direct line of descent of an existing animal. With the generosity of true greatness, he gave up his own opinions in the face of new truth, and took my conclusions as the basis of his famous New York lecture on the horse” (Life, i, p. 462).

The American trip included a week at Niagara, where the falls gave Huxley enormous pleasure, not merely as a spectacle, but also as a standard instance of a particular sort of geological action. The scientific enjoyment derived from the study of the latter only served to heighten the artistic impression.

On September 12, his “Address on University Education” was delivered without notes, at the opening of the Johns Hopkins University, Baltimore (Coll. Essays, iii, p. 235). The “educational ladder” so much talked of in these later days, is here advocated:—

“The primary school and the university are the alpha and omega of education.”

Secondary schools, if established, should be true intermediaries,—

“. . . keeping on the wide track of general culture, and not sacrificing one branch of knowledge for another.”

The university student should be subjected to an initial test at the end of his first term. Within the limits of a prescribed curriculum there should be a free choice of subjects. Half the fortune of the pious founder had been devoted to establishing a hospital in Baltimore, and hence some part of this address is devoted to the question of medical education, from which Huxley suggests that zoology, botany and materia medica should be excluded,

the elements of the two first being a fitting part of an earlier stage.

The Johns Hopkins University was established with special reference to the encouragement of research, regarding which we read :—

“ But so sure as it is that men live not by bread, but by ideas, so sure is it that the future of the world lies in the hands of those who are able to carry the interpretation of nature a step further than their predecessors ; so certain is it that the highest function of a university is to seek out those men, cherish them, and give their ability to serve their kind full play.”

The waste of money on mere architecture is deprecated, a plea entered for reasonable payment of the staff, and that these with other experts should be properly represented on the governing body, if only in the interest of good and rational appointments to the professoriate.

The address concludes with the expression of a firm belief in the future of America,—

“ . . . but the one condition of success, your sole safeguard, is the moral worth and intellectual clearness of the individual citizen.”

The three lectures on Evolution were delivered at New York on September 18, 20 and 22 (Coll. Essays, iv, p. 46). The first deals with “ The Three Hypotheses respecting the History of Nature,” *i.e.*, that of perpetual sameness, the special creation hypothesis, and the doctrine of evolution. This leads on to the second lecture on “ The Hypothesis of Evolution: the Neutral and the Favourable Evidence,” and this again to the third lecture on “ The Demonstrative Evidence of Evolution,” illustrated by the special case of the horse, for which the American strata furnish such valuable materials. The results derived from a study of these were embodied in a lecture

given at the London Institution on December 4, entitled, "On Recent Additions to the Knowledge of the Pedigree of the Horse."

Huxley left New York on September 23, and his visit to America must be regarded as marking the commencement of a new stage in his career. Mr. Leonard Huxley thus summarizes the nature of his reception and its import:—

"Certainly the people of the States gave him an enthusiastic welcome; his writings had made him known far and wide; as the manager of the Californian department of the Philadelphia Exhibition told him, the very miners of California read his books over their camp fires; and his visit was so far like a royal progress, that unless he entered a city disguised under the name of Jones or Smith, he was liable not merely to be interviewed, but to be called upon to 'address a few words' to the citizens. . . . His reception in America may be said to emphasize his definite establishment in the first rank of English thinkers. It was a signal testimony to the wide extent of his influence, hardly suspected, indeed, by himself; an influence due above all to the fact that he did not allow his studies to stand apart from the moving problems of existence, but brought the new and regenerating ideas into contact with life at every point, and that his championship of the new doctrines had at the same time been a championship of freedom and sincerity in thought and word against shams and self-deceptions of every kind. It was not so much the preacher of new doctrines who was welcomed, as the apostle of veracity—not so much the teacher of science as the teacher of men" (Life, i, p. 460).

The lectures, etc., delivered in the States were published in 1877 under the title of *American Addresses*. In this volume was also included a lecture "On the Study of Biology" (Sci. Mem., iv, xiv, p. 248. Coll. Essays, iii, p. 262), given at South Kensington on December 16 (1876) in connection with the Loan Collection of Scientific Apparatus. It is pointed out that the idea of establishing a science of life (biology), bringing together the

disciplines dealing with organisms and their functions, occurred independently to three contemporaries, Bichat, Lamarck and Treviranus. Lamarck first used the word "Biologie," and Treviranus wrote a *Biologie* in six volumes (1802-22).

The reasons for studying biology are next set forth. Its utility is obvious from the fact that it,

" . . . tends to give right ideas, which are essential to the foundation of right practice, and to remove wrong ideas, which are the no less essential foundations and fertile mothers of every description of error in practice."

Another reason for the study is to be found in the consideration that man is not an isolated and peculiar being, but one of a series of organisms, displaying unity in structure and function. The important bearings of the subject on infectious disease, and its value to agriculture are finally pointed out.

As to the method of studying biology, the type system, as adopted at South Kensington, is advocated. The importance of rationally arranged museums is also emphasized. The needs of the general public in this respect are,—

" . . . not met by constructing a sort of happy hunting-ground of miles of glass cases; and, under the pretence of exhibiting everything, putting the maximum amount of obstacle in the way of those who wish properly to see anything."

As to the time when biology may best be studied, it is held that this should form part of an ordinary school training. Human anatomy and physiology, and also botany, are pointed out as the most suitable branches of the subject for the purpose. Special classes, with practical work, might well be established in secondary schools.

Six lectures to working-men "On the Evidence as to the Origin of Existing Vertebrate Animals" were given

in the Royal School of Mines this year (*Nature*, xiii, 1876, pp. 388-9, 410-12, 429-30, 467-9, 514-6; xiv, 1876, pp. 33-4. *Sci. Mem.*, iv, xii, p. 163). The recent advances made in palæontology are here lucidly explained:—

“The accurate information obtained in this department of science has put the *fact* of evolution beyond a doubt; formerly, the great reproach of the theory was, that no support was lent to it by the geological history of living things; now, whatever happens, the fact remains that the hypothesis is founded on the firm basis of palæontological evidence.”

During 1876, too, a memoir was published “On the Nature of the Craniofacial Apparatus of *Petromyzon*” (*J. Anat. and Physiol.*, x, 1876, pp. 412-29. *Sci. Mem.*, iv, x, p. 128).—This deals with the skeleton of the head in the lamprey, the complicated elements of which are described with the most painstaking accuracy. The interpretation given to some of them, however, has not met with general acceptance.

1877.

A good deal of time was taken up during 1877 in furthering educational interests of various kinds. Huxley's work as a member of the Scottish Universities Commission necessitated three visits to Edinburgh, and the intimate acquaintance he had gained of the Scottish system would seem to have made a favourable impression as to its worth, in strong contrast with his consistently uncompromising attitude in regard to those supposedly effete centres of learning, Oxford and Cambridge. At any rate his eldest son was entered as a student at St. Andrews in the fall of the year; though he subsequently went up to Oxford.

The legislation which had been the outcome of the report of the Vivisection Commission suggested a lecture on "Elementary Instruction in Physiology," delivered at the Anthropological Conference on May 22 (Coll. Essays, iii, p. 294). Here animal physiology is spoken of as an essential part of domestic economy, and Huxley's supposed desire to introduce vivisection into school teaching disclaimed. The infliction of pain on animals for the purposes of gain or sport is strongly deprecated.

For some time the necessity for promoting a proper system of technical education had been strongly borne in upon some of the more enlightened members of the community, the Clothworkers' Company and the Society of Arts co-operating to this end. In July of this year a committee of the City Companies applied to Huxley, among others, for a statement of his opinions regarding the aims and methods of technical education. The following paragraph, taken from the extensive report he supplied, goes to the root of the matter:—

"It appears to me that if every person who is engaged in an industry had access to instruction in the scientific principles on which that industry is based; in the mode of applying these principles to practice; in the actual use of the means and appliances employed; in the language of the people who know as much about the matter as we do ourselves; and lastly, in the art of keeping accounts, Technical Education would have done all that can be required of it."

An address on "Technical Education," given at the Working Men's Club and Institute, on December 1, gives further expression to Huxley's ideas on the subject (Coll. Essays, iii, p. 404). Since an anatomist may be regarded as a handicraftsman, he excuses himself for venturing into the only educational domain with which

he had so far had nothing to do. The address then proceeds to consider what preliminary instruction an anatomist should receive. There should be good elementary education, including the elements of physical science, especially physics and chemistry. The power of reading Latin, French, and German should be acquired. Some attention ought to be paid to drawing, and physical training is an essential.

The dangers of attempting too much are depicted. Children subjected to educational over-pressure are,—

“ . . . conceited all the forenoon of life, and stupid all its afternoon.”

Speaking of the preparatory education of the handicraftsman, Huxley says that this should have nothing “technical” about it, for, “the workshop is the only real school for a handicraft.” Intellectual gear is not the only equipment of value:—

“Activity, probity, knowledge of men, ready mother-wit, supplemented by a good knowledge of the general principle involved in his business, are the making of a good foreman.”

Provision should be made for giving lads of real ability a chance.

He continued for a number of years to take an active interest in technical education, and his warm advocacy of the movement had much to do with the establishment of the Cowper Street Schools, and the Central Institution of the City and Guilds of London, which took place in 1881.

The University of Cambridge conferred the degree of LL.D. (*honoris causâ*) upon Charles Darwin in November, and at the Philosophical Club dinner, held the same evening, Huxley paid an eloquent tribute to him (in his

absence). The tardiness of Cambridge in recognizing one of her greatest sons was delicately hinted at, and though in a letter to Darwin (dated November 21) deliberate sneering is denied, a milder form of sarcasm is admitted :—

“ There was only a little touch of the whip at starting, and it was so tied round with ribbons that it took them some time to find out where the flick had hit ” (Life, i, p. 479).

If the following extract from Huxley's notes of the speech fairly represents the utterance, the “ ribbons ” would distinctly add to the unpleasantness of the “ flick.” It was, however, an after-dinner speech :—

“ Mr. Darwin's work had fully earned the distinction you have conferred upon him four-and-twenty years ago ; but I doubt not that he would have been found in that circumstance an exemplification of the wise foresight of his revered intellectual mother. Instead of offering her honours when they ran a chance of being crushed beneath the accumulated marks of approbation of the whole civilized world, the University has waited until the trophy was finished, and has crowned the edifice with the delicate wreath of academic appreciation ” (Life, i, p. 480).

Examples have already been given to show that if Huxley's unrivalled power of scathing sarcasm was often manifested, generosity and kindness of heart were even more characteristic. Mr. Leonard Huxley records a good instance for 1877 (Life, i, p. 482) :—

“ A German scientific worker in England, whom we will call H., had fallen into distress, and applied to him for help, asking if some work could not be put in his way. Huxley could think of nothing immediate but to suggest some lessons in German literature to his children, though in fact they were well provided for with a German governess. . . . ”

An unnamed donor, however, furnished the necessary

money, in response to a request from Huxley, who says in a letter to his wife :—

“ It came in the nick of time, as H. came an hour or two after it arrived, and with many apologies told me he was quite penniless. The poor old fellow was quite overcome when I told him of how matters stood, and it was characteristic that as soon as he got his breath again, he wanted to know when he would begin teaching the children.”

Besides those already-mentioned, lectures were given this year on “ Starfishes and their Allies ” (March 7, Royal Institution) ; “ The Geological History of Birds ” (June 7, Zoological Gardens) ; and “ Belemnites ” (December 17, London Institution).

The article on “ Evolution ” (Coll. Essays, ii, p. 187), for the 9th edition of the *Encyclopædia Britannica* was completed this year, but did not appear till the following. There is evolution of the individual (ontogeny), and evolution of animal groups (phylogeny). The study of the latter, as based on observation followed by speculation, does not go further back than the seventeenth century, and Harvey’s work serves as a point of departure. The subject matter is grouped under eight headings :—

1. Cartesianism, a mechanical theory of the physical universe, Descartes, Spinoza, and Leibnitz, De Maillet, Buffon, Erasmus Darwin, Goethe, Lamarck, Treviranus, Charles Darwin, Wallace, Spencer, and Haeckel.

2. Gradations of Structure among Living Beings, Leeuwenhoek and Swammerdam, Lamarck, Cuvier and Von Baer.

3. Analogy between Ontogeny and Phylogeny, Meckel.

4. Morphology, or Form and Structure ; Variations on a Common Plan, Belon and Wolff.

5. Vestigial or Rudimentary Organs.

6. Influence of a Changing Environment in Modifying Organisms. Climate, Station and Hybridization recognized before the time of Treviranus. Use and Disuse, advanced as factors by Lamarck. Ultimately Darwin's theory of Natural Selection.

7. Geographical Distribution, Darwin and Wallace.

8. Geological Succession, Darwin and Wallace. Rüttimeyer, Kowalewsky, Marsh, and Huxley. Work on pedigrees of Mammals and Crocodiles.

The strongest evidence in favour of Evolution afforded by 7 and 8.

Two important books also appeared in 1877, *i.e.*, *Physiography* and *The Anatomy of Invertebrated Animals*. The former embodies the preliminary lectures which Huxley had given for some sessions as an introduction to his regular course (see p. 37), and of which the Thames basin furnished the main theme. This work had an extensive circulation for many years, and a judiciously edited revised edition has recently been put before the public. With the intention, apparently, of encouraging the teaching of general principles as laid down by Huxley, the Science and Art Department added "Physiography" to their list of subjects, the first examination being held in May 1878. The result was unfortunate, for the syllabus was conceived in a singularly unscientific spirit, and consisted of an extraordinary aggregate of disjecta membra. The subject, indeed, was about as unscientific as the "General Elementary Science," of which so much has been heard during late years. But we must remember that it belongs to the time when any degree of any British University qualified its possessor to earn Government grants in any science or pseudo-science subject, from Pure Mathematics and Naval Construction to the Principles of Agriculture.

The Anatomy of Invertebrated Animals shares many of the characteristics of the sister work on Vertebrates, published in 1871, and embodies a large amount of Huxley's own original researches. It does not, however, reach the same high level of excellence.

One scientific memoir has to be mentioned for 1877—“The Crocodilian Remains found in the Elgin Sandstones, with Remarks on the Ichnites [*i.e.*, fossil footprints] of Cummingstone” (Mem. Geol. Survey U.K., Monograph III, 1877. Sci. Mem., iv, XIII, p. 188).—This deals chiefly with the remains of the primitive extinct crocodile *Stagonolepis* (*cf.* p. 127).

CHAPTER XIV

HARVEY AND HUME—CRAYFISHES—DUBLIN AND
CAMBRIDGE DOCTORATES [1878-79].

DURING the early part of 1878, immediately after the marriage of his eldest daughter, Huxley's work was greatly interfered with by an outbreak of diphtheria in his family, which occasioned the most serious anxiety. His then demonstrator, the late Prof. T. J. Parker, writes of this :—

“I never saw a man more crushed than he was during the dangerous illness of one of his daughters, and he told me that, having then to make an after-dinner speech, he broke down for the first time in his life, and for one painful moment forgot where he was and what he had to say.”

To which his private assistant at the time, the late Prof. G. B. Howes, adds :—

“When, after two days, he looked in at the laboratory, his dejected countenance and tired expression betokened only too plainly the intense anxiety he had undergone” (*Life*, i, p. 492).

While the above exemplifies Huxley's devotion as a father, the visit of Prof. Marsh to England just after this trying time, illustrates his character as a friend. Of this Marsh himself writes as follows (*Recollections*, p. 6) :—

“How kind Huxley was to every one who could claim his friendship, I have good cause to know. Of the many instances

which occur to me, one will suffice. One evening in London, at a grand annual reception of the Royal Academy, where celebrities of every rank were present, Huxley said to me, ‘When I was in America, you showed me every extinct animal that I had read about, or even dreamt of. Now, if there is a single living lion in all Great Britain that you wish to see, I will show him to you in five minutes?’ He kept his promise, and before the reception was over, I had met many of the most noted men in England, and from that evening, I can date a large number of acquaintances, who have made my subsequent visits to that country an ever-increasing pleasure” (Life, i, p. 494).

Huxley’s anxiety at this time about the failing health of Prof. W. K. Clifford affords further evidence, were such necessary, of his sterling character as a friend.

Another personal matter of the year was the conferment of the degree of LL.D. (*honoris causa*) of the University of Dublin, which took place during the meeting of the British Association, where he had delivered an address to the section on Anthropology. The subject was “Informal Remarks on the Conclusions of Anthropology,” the central point being that Man is a legitimate subject of scientific study, and that the possibility of his origin by a process of evolution must be admitted (Nature, xviii, 1878, pp. 445-8. Sci. Mem., iv, xv, p. 265).

In a letter to his eldest daughter later in the year (December 7), upon the Afghan war, Huxley shows that absorbing scientific and educational work did not preclude a lively interest in political events and the welfare of the empire :—

“I am strong for justice as any one can be, but it is real justice, not sham conventional justice which the sentimentalists howl for.

“At this present time real justice requires that the power of

England should be used to maintain order and introduce civilization wherever that power extends.

"The Afghans are a pack of disorderly, treacherous, blood-thirsty thieves and caterans, who should never have been allowed to escape from the heavy hand we laid upon them, after the massacre of twenty thousand of our men, women (and) children in the Khoord Cabul Pass thirty years ago.

"We have let them be, and the consequence is they now lend themselves to the Russians, and are ready to stir up disorder and undo all the good we have been doing in India for the last generation.

"They are to India exactly what the Highlanders of Scotland were to the Lowlanders before 1745; and we have just as much right to deal with them in the same way.

"I am of opinion that our Indian Empire is a curse to us. But so long as we make up our minds to hold it, we must also make up our minds to do those things which are needful to hold it effectually, and in the long-run it will be found that so doing is real justice both for ourselves, our subject population, and the Afghans themselves" (Life, i, p. 489).

As regards scientific work, 1878 must be described as a Harvey, Hume and Crayfish year. The first direction of activity was dictated by the fact that April 1 was the tercentenary of Harvey's birth. On January 25, Huxley lectured at the Royal Institution on "William Harvey" (Fortnightly Review, New Ser., xxiii, 1878, pp. 167-90. Sci. Mem., iv, xviii, p. 319). In this lecture Harvey's scientific attitude is shown to be independent of the Baconian philosophy, and occasion is taken to make an attack on the extreme views of anti-vivisectionists. A speech on Harvey was also delivered at the Memorial Meeting, held on July 18, by the College of Physicians.

A book on *Hume* took the form of a volume of the *English Men of Letters Series*, written at the request of the General Editor, Mr. (now the Right Hon.) John Morley. Huxley's strong philosophical predilections here find full expression. A few quotations will at the

same time illustrate his philosophical attitude, and his power as a writer.

The Preface (dated January 1894) to the sixth volume of the *Collected Essays*, most of which is a reprint of the *Hume*, begins with an eloquent tribute to Descartes and Socrates, but Plato is severely handled :—

“The Platonic philosophy is probably the grandest example of the unscientific use of the imagination extant; and it would be hard to estimate the amount of detriment to clear thinking effected, directly and indirectly, by the theory of ideas, on the one hand, and by the unfortunate doctrine of the baseness of matter, on the other.”

Berkeley and Hume are then mentioned as the greatest philosophical reformers since Descartes, and the following advice is given to those who wish to acquire a sound knowledge of philosophy, but do not desire merely “to discourse fluently and learnedly about philosophical questions . . .” :—

“If . . . you are animated by the much rarer desire for real knowledge; if you want to get a clear conception of the deepest problems set before the intellect of man, there is no need, so far as I can see, for you to go beyond the limits of the English tongue. Indeed, if you are pressed for time, three English authors will suffice; namely, Berkeley, Hume, and Hobbes.

“If you will lay your minds alongside the works of these great writers—not with the view of merely ascertaining their opinions, still less for the purpose of indolently resting upon their authority, but to the end of seeing for yourselves how far what each says has its foundation in right reason—you will have had as much sound philosophical training as is good for any one but an expert. And you will have had the further advantage of becoming familiar with the manner in which three of the greatest masters of the English language have handled that noble instrument of thought.”

A vigorous sketch of Hume's Life occupies the first

part of the book, while the second and larger part is taken up by Hume's philosophy. The following passages near the end of the former, having reference to Hume's self-selected place of burial on the Calton Hill, are among the finest of their kind that Huxley ever penned :—

“From the summit of this hill, there is a prospect unequalled by any to be seen from the midst of a great city. Westward lies the Forth, and beyond it, dimly blue, the far-away Highland hills; eastward, rise the bold contours of Arthur's Seat and the rugged crags of the Castle rock, with the gray Old Town of Edinburgh; while, far below, from a maze of crowded thoroughfares, the hoarse murmur of the toil of a polity of energetic men is borne upon the ear. At times a man may be as solitary here as in a veritable wilderness; and may meditate upon the epitome of nature and of man—the kingdoms of this world—spread out before him.

“Surely, there is a fitness in the choice of this last resting-place by the philosopher and historian, who saw so clearly that these two kingdoms form but one realm, governed by uniform laws and alike based on impenetrable darkness and eternal silence; and faithful to the last to that profound veracity which was the secret of his philosophic greatness, he ordered that the simple Roman tomb which marks his grave should bear no inscription but

DAVID HUME,

BORN 1711.

DIED 1776.

Leaving it to posterity to add the rest.

“It was by the desire and at the suggestion of my friend, the Editor of this Series, that I undertook to attempt to help posterity in the difficult business of knowing what to add to Hume's epitaph; and I might, with justice, throw upon him the responsibility of my apparent presumption in occupying a place among the men of letters, who are engaged with him, in their proper function of writing about English Men of Letters.

“That to which succeeding generations have made, are making, and will make, continual additions, however, is Hume's fame as a philosopher; and, though I know that my plea will

add to my offence in some quarters, I must plead, in extenuation of my audacity, that philosophy lies in the province of science, and not in that of letters."

To demonstrate the scientific nature of Hume's philosophy would appear to be the chief aim of the sequel of Huxley's book. The view stated in the last sentence of the above quotation is expanded in Chap. I. "On the Object and Scope of Philosophy":—

"If the origin of the contents of the mind is truly a philosophical problem, then the philosopher who attempts to deal with that problem, without acquainting himself with the physiology of sensation, has no more intelligent conception of his business than the physiologist, who thinks he can discuss locomotion, without an acquaintance with the principles of mechanics; or respiration, without some tincture of chemistry. On whatever ground we term physiology, science, psychology is entitled to the same appellation. . . . Hence, as philosophy is, in great measure, the exponent of the logical consequences of certain data established by psychology . . . it would seem to be an obvious conclusion that philosophers are likely to be successful in their inquiries, in proportion as they are familiar with the application of scientific method to less abstruse subjects. . . . And it is accordant with this presumption, that the men who have made the most important positive additions to philosophy, such as Descartes, Spinoza and Kant, not to mention more recent examples, have been deeply imbued with the spirit of physical science; and, in some cases, such as those of Descartes and Kant, have been largely acquainted with its details. . . . In truth, the laboratory is the fore-court of the temple of philosophy; and whoso has not offered sacrifices and undergone purification there, has little chance of admission into the sanctuary" (pp. 60-1).

Then follows the application to the case of Hume:—

"It is assuredly one of Hume's greatest merits that he clearly recognised the fact that philosophy is based upon psychology; and that the inquiry into the contents and the operations of the mind must be conducted upon the same

principles as a physical investigation, if what he calls the 'moral philosopher' would attain results of as firm and definite a character as those which reward the 'natural philosopher'" (pp. 62-3).

Similarly in Chap. III. "On the Origin of the Impressions":—

"... As a further set-off to Hume's credit, it must be noticed that he grasped the fundamental truth, that the key to the comprehension of mental operations lies in the study of the molecular changes of the nervous apparatus by which they are originated" (p. 94).

And again in Chap. V. on "The Mental Phenomena of Animals":—

"It is a remarkable example of Hume's sagacity that he perceived the importance of a branch of science which, even now, can hardly be said to exist; and that, in a remarkable passage, he sketches in bold outlines the chief features of comparative psychology" (p. 126).

Huxley's own views on the distinction between genius and talent, given at the end of the same chapter, are also interesting:—

"The child who is impelled to draw as soon as it can hold a pencil; the Mozart who breaks out into music as early; the boy Bidder who worked out the most complicated sums without learning arithmetic; the boy Pascal who evolved Euclid out of his own consciousness: all these may be said to have been impelled by instinct, as much as are the beaver and the bee. And the man of genius is distinct in kind from the man of cleverness, by reason of the working within him of strong innate tendencies—which cultivation may improve, but which it can no more create, than horticulture can make thistles bear figs. The analogy between a musical instrument and the mind holds good here also. Art and industry may get much music, of a sort, out of a penny whistle; but, when all is done, it has no chance against an organ. The innate musical potentialities of the two are infinitely different" (pp. 132-3).

In Chap. VII. on "The Order of Nature : Miracles," we find Huxley's notable parallel between miracles and centaurs:—

"And nothing short of a careful monograph, by a highly competent investigator, accompanied by figures and measurements of all the most important parts of a centaur, put forth under circumstances which could leave no doubt that falsification or misinterpretation would meet with immediate exposure, could possibly enable a man of science to feel that he acted conscientiously, in expressing his belief in the existence of a centaur on the evidence of testimony.

"This hesitation about admitting the existence of such an animal as a centaur, be it observed, does not deserve reproach, as scepticism, but moderate praise, as mere scientific good faith. It need not imply, and it does not, so far as I am concerned, any *à priori* hypothesis that a centaur is an impossible animal : or, that his existence, if he did exist, would violate the laws of nature. Indubitably, the organization of a centaur presents a variety of practical difficulties to an anatomist and physiologist ; and a good many of those generalizations of our present experience, which we are pleased to call laws of nature, would be upset by the appearance of such an animal, so that we should have to frame new laws to cover our extended experience. Every wise man will admit that the possibilities of nature are infinite, and include centaurs ; but he will not the less feel it his duty to hold fast, for the present, by the dictum of Lucretius, 'Nam certe ex vivo Centauri non fit imago,' and to cast the entire burthen of the proof, that centaurs exist, on the shoulders of those who ask him to believe the statement. Judged by the canons either of common sense, or of science, which are indeed one and the same, all 'miracles' are centaurs, or they would not be miracles ; and men of sense and science will deal with them on the same principles" (pp. 160-1).

Huxley's concluding remarks in the last chapter (XI.) on "The Principles of Morals," are also well worth quoting:—

"In which ever way we look at the matter, morality is based on feeling, not on reason ; though reason alone is competent to

trace out the effects of our actions and thereby dictate conduct. Justice is founded on the love of one's neighbour ; and goodness is a kind of beauty. . . . And as there are Pascals and Mozarts, Newtons and Raffaelles, in whom the innate faculty for science or art seems to need but a touch to spring into full vigour, and through whom the human race obtains new possibilities of knowledge and new conceptions of beauty : so there have been men of moral genius, to whom we owe ideals of duty and visions of moral perfection, which ordinary mankind could never have attained : though, happily for them, they can feel the beauty of a vision, which lay beyond the reach of their dull imaginations, and count life well spent in shaping some faint image of it in the actual world" (pp. 240-1).

Some time during 1878 Huxley had drafted out a scheme for an *English Men of Science Series*, which Messrs. Macmillan proposed to publish. His own share was to consist of Harvey and Darwin. The project, however, was not carried out.

The scientific interest of the year chiefly centres in Crustaceans. Lectures on the Crayfish were given at Jermyn Street to working-men (April 29-June 3), and a course on Crustaceous Animals was delivered at the Zoological Gardens (May 17-June 21). Besides which a communication was made to the Zoological Society "On the Classification and the Distribution of the Crayfishes" (Proc. Zool. Soc., 1878, pp. 752-88. Read June 4, 1878. Sci. Mem., iv, xvi, p. 275).

Huxley also described a new kind of dissecting microscope he had devised, in a Presidential Address to the Quekett Club (J. Quekett Micros. Club, v, 1878-9, pp. 144-5. Delivered November 22, 1878. Sci. Mem., iv, xvii, p. 316).

1879.

During this year Huxley was elected a Governor of Eton, and in this capacity was able, later on, to

give effect to some of his views regarding secondary education.

One of the most interesting personal events of 1879 took place at Cambridge on June 10, when he received the degree of LL.D. (*honoris causâ*). The following speech was delivered on the occasion by Mr. Sandys, the Public Orator:—

“Academi inter silvas qui verum quærunt, non modo ipsi veritatis lumine vitam hanc umbratilem illustrare conantur, sed illustrissimum quemque veritatis investigatorem aliunde delatum ea qua par est comitate excipiunt. Adest vir cui in veritate exploranda ampla sane provincia contigit, qui sive in animantium sive in arborum et herbarum genere quicquid vivit investigat, ipsum illud vivere quid sit, quali ex origine natum sit: qui exquirat quæ cognitionis necessitudo inter priores illas viventium species et has quæ etiam nunc supersunt, intercedat. Olim in Oceano Australi, ubi rectis, ‘oculis monstra natantia’ vidit, victoriam prope primam, velut alter Perseus, a Medusa reportavit; varias deinceps animantium formas quasi ab ipsa Gorgone in saxum versas sagacitate singulari explicavit; vitæ denique universæ explorandæ vitam suam totam dedicavit. Physicorum inter principes diu honoratus, idem (ut verbum mutuemur a Cartesio illo cujus laudes ipse in hac urbe quondam prædicavit) etiam ‘metaphysica’ honore debito prosecutus est. Illum demum liberalitur educatum esse existimat qui cum ceteris animi et corporis dotibus instructus sit, tum præsertim quicquid turpe sit oderit, quicquid sive in arte sive in rerum natura pulchrum sit diligat; neque tamen ipse (ut ait Aristoteles) ‘animalium parum pulchrorum contemplationem fastidio puerili reformidat;’ sed in perpetua animantium serie hominis vestigia perscrutari conatus, satis ampla liberalitate in universa rerum natura ‘humani nihil a se alienum putat.’ Duco ad vos virum intrepidum, facundum, propositi tenacem, Thomam Henricum Huxley” (Life, ii, p. 4).

By a somewhat curious coincidence one of the descriptive expressions at the end of the speech embodied the Huxley motto, “Propositi tenax.” The academic recognition from Cambridge would appear to have given

pleasure to the recipient, not unmixed with amusement, for in a letter written to Baynes the previous day he says:—

“I shall be glorious in a red gown at Cambridge to-morrow, and hereafter look to be treated as a PERSON OF RESPECTABILITY. I have done my best to avoid that misfortune, but it's of no use” (Life, ii, p. 4).

One of the earliest lectures of the year was a Friday Evening Discourse, delivered at the Royal Institution, “On Sensation and the Unity of Structure of Sensiferous Organs” (Nineteenth Century, v, 1879, pp. 597-611. Sci. Mem., iv, xx, p. 357. Coll. Essays, vi, p. 288). Descartes is claimed as being the first enunciator “of the essential elements of the true theory of sensation,” and the subsequent progress of opinion sketched. The essential parts of the chief sense organs are shown to arise from the external layer of the embryo, while the differences between these organs are explained as adaptations to stimuli of different kind. And a sensation is finally defined as,—

“the equivalent in terms of consciousness for a mode of motion of the matter of the sensorium.”

The metaphysical side of the question is of course dealt with, for,—

“In truth, the attempt to nourish the human intellect upon a diet which contains no metaphysics is about as hopeful as that of certain Eastern sages to nourish their bodies without destroying life. . .

“By way of escape from the metaphysical Will-o'-the-wisps generated in the marshes of literature and theology, the serious student is sometimes bidden to betake himself to the solid ground of physical science, but the fish of immortal memory, who threw himself out of the frying-pan into the fire, was not more ill-advised than the man who seeks sanctuary from philosophical

persecution within the walls of the observatory or of the laboratory. It is said that 'metaphysics' owe their name to the fact that, in Aristotle's works, questions of pure philosophy are dealt with immediately after those of physics. If so, the accident is happily symbolical of the essential relations of things; for metaphysical speculation follows as closely upon physical theory as black care upon the horseman."

At the end of the essay Idealist and Materialist are alike criticized, and the concluding passage runs:—

"Strike out the propositions about which neither controversialist does or can know anything, and there is nothing left for them to quarrel about. Make a desert of the Unknowable, and the divine Astræa of philosophic peace will commence her blessed reign."

A lecture on "Snakes" was given at the Zoological Gardens on June 5, and repeated at the London Institution on December 1. As President of the Quekett Club, Huxley delivered a stimulating Annual Address (J. Quekett Micros. Club, v, 1878-9, pp. 250-5. Delivered July 25, 1879. Sci. Mem., iv, XXI, p. 374). The interest lies in certain suggestions made to amateur naturalists as to the kind of work by which they can best assist in the advancement of science.

There are some respects in which amateurs are better off than professional scientists. For they are not obliged, like many of the latter, to keep fully abreast of research in all lines, and often have leisure to pursue a kind of detailed work from which the professional, for lack of time, must keep aloof:—

"If I may say so without offence, such amusement may be regarded as an involuntary ploughing and harrowing of the ground, making it receptive of the seeds of science, and preparing it for rich harvests in the future. So, as I said before, whatever member of the Club has joined it for the sake of mere amusement has done a good thing for himself, and has done

probably more than he knows to help those who make these pursuits the serious business of their lives."

Dallinger and Drysdale's patient work on the Infusoria is commended as a pattern, his own researches on the Crayfish are alluded to, and a tribute paid to Lyonet who,

"spent many years over his caterpillar, and the result was a monograph that will last for all time."

In 1868 he had described certain jelly-like masses, found in deep-sea soundings, as a primitive animal, on which the name of "Bathybius Haeckelii" was conferred. The researches of the *Challenger* subsequently proved the supposed organism to be a chemical precipitate due to the action of the alcohol used as a preservative. At the British Association, held this year at Sheffield, Huxley publicly admitted his error in the course of a humorous speech. And when, in his regular course of lectures the following winter, this pseudo-organism was spoken about, he added:—

"And I can say, gentlemen, without petulance, that I heartily wish Bathybius were at the bottom of the sea."

A particularly interesting book was published in 1879 under the title of *The Crayfish: An Introduction to the Study of Zoology*. This was part of the result of much time devoted to the study of Crustaceans, and is a masterpiece of lucid exposition. The structure, functions, development, etc. of the crayfish are described in a luminous fashion, and employed as a basis for illustrating the more important general principles of zoology. The work has proved of the greatest value to many successive generations of students, and will always be regarded as a classic.

This year, too, Huxley completed his *Introductory Primer* to Macmillan's *Science Primer Series*, but it did not appear till the following year.

Two scientific memoirs of the year are as follows :—

1. "On the Characters of the Pelvis in the Mammalia, and the Conclusions respecting the Origin of Mammals which may be based on them" (Proc. Roy. Soc., xxviii, 1879, pp. 395-405. Read March 6, 1879. Sci. Mem., iv, xix, p. 345).—That Mammals have descended from Amphibians is the conclusion at which the memoir arrives. It has now been superseded by the theory of a reptilian origin.

2. "On Certain Errors respecting the Structure of the Heart attributed to Aristotle" (Nature, xxi, 1879, pp. 1-5. Sci. Mem., iv, xxii, p. 380).—It is illustrative of Huxley's untiring energy that in late middle life, in spite of exacting and numerous activities, he should begin the study of Greek, actuated with the desire of studying Aristotle and the Greek Testament first hand. The paper now under consideration was one result of this self-imposed task.

Aristotle describes the mammalian heart as consisting of three instead of four chambers. The explanation is that what is now called the right auricle was considered to be a swelling of the great veins. The following estimate of Aristotle's powers as a naturalist finds a place in the paper :—

"He carried science a step beyond the point at which he found it; a meritorious, but not a miraculous, achievement. What he did required the possession of very good powers of observation; if they had been powers of the highest class he would hardly have left such conspicuous objects as the valves of the heart to be described by his successors."

CHAPTER XV

PRESIDENT OF THE ROYAL SOCIETY [1880-83].

PROBABLY the most interesting lecture for 1880 was the Friday Evening Discourse, "On the Coming of Age of the Origin of Species," delivered at the Royal Institution on March 19 (Nature, xxii, 1880, pp. 1-4. Sci. Mem., iv, xxiv, p. 395. Coll. Essays, ii, p. 227).—Here Huxley tells us that,—

" . . . having conceived a tender affection for a child of what appeared to me to be of such remarkable promise, I acted for some time in the capacity of a sort of under-nurse, and thus came in for my share of the storms which threatened the life of the young creature."

Since those days the exactly opposite danger of accepting the main doctrines without reflection had become apparent, a tendency to be deprecated,—

" . . . for the scientific spirit is of more value than its products, and irrationally held truths may be more harmful than reasoned errors . . . the essence of the scientific spirit is criticism."

The prophetic character of the *Origin* is pointed out, and illustrated by the palæontological discoveries made since its publication, as well as by Hofmeister's pioneer work on vascular cryptogams, which helped to erase one of the supposed sharp boundary lines in the vegetable kingdom.

Another address of the year "On the Method of Zadig: Retrospective Prophecy as a Function of Science,"

was given at the Working Men's College (Coll. Essays, iv, p. 1). Zadig is the hero of a little romance written by Voltaire, where he figures as a sort of Babylonian Sherlock Holmes. Cuvier alludes to Zadig in his great work on *Ossemens Fossiles*. The object of Huxley's address is to show that scientific method as practised by Cuvier and scientists in general is no other than the method of common sense applied by Zadig to matters unscientific.

He also delivered the opening address for the Josiah Mason Science College at Birmingham, on October 1. It was entitled "Science and Culture" (Coll. Essays, iii, p. 134). Priestley, as a Birmingham celebrity (whose statue Huxley had unveiled in 1874, *cf.* p. 120), is naturally mentioned at the beginning of the address. Fame was not his chief desire, for the study of his life leaves no doubt that he,—

" . . . set a much higher value upon advancement of knowledge, and the promotion of that freedom of thought which is at once the cause and the consequence of intellectual progress."

The foundation of Mason's College is regarded as an important recognition of the claims of physical science, and with special reference to the technical needs of Birmingham, it is asserted that,—

" . . . the diffusion of thorough scientific education is an absolutely essential condition of industrial progress, and that the College which has been opened to-day will confer an inestimable boon upon those whose livelihood is to be gained by the practice of the arts and manufactures of the district."

The conditions of the endowment excluded party politics, theology and "mere literary instruction and education." Huxley expresses sympathy with the last restriction, in so far as it means,—

"The ordinary classical course of our schools and universities.

. . . Its inclusion would probably lead to the introduction of the ordinary smattering of Latin and Greek."

It is interesting to note that Mason's College found itself very much hampered by the limitations as to literature, etc., imposed, and it gradually found ways and means to convert itself into an University College of the ordinary kind.

The impression made by Huxley on one of his literary contemporaries finds expression this year in Skelton's *Crookit Meg*, where the village sage and sutor is thus described (p. 72):—

"For the rest it will be enough to add that this long, gaunt, bony cobbler of old boats was—was (may I take the liberty, Mr. Professor?) a village Huxley of the year One. The colourless brilliancy of the great teacher's style, the easy facility with which the drop of light forms itself into a perfect sphere as it falls from its pen, belong indeed to a consummate master of the art of expression, which Adam of course was not; but the mental lucidity, justice, and balance, as well as the reserve of power, and the Shakespearian gaiety of touch, which made the old man one of the most delightful companions in the world, were essentially Huxleian."

The scientific interest of 1880 centres about the dog, on which Huxley intended to write a companion volume to his *Crayfish*, though the intention was never carried out. Two lectures were delivered at the Royal Institution "On Dogs, and the Problems connected with them" (April 6 and 13), and working-men, at Jermyn Street, had also the opportunity of learning something on the subject. Two memoirs represent the technical side of the matter:—

1. "On the Epipubis in the Dog and the Fox" (Proc. Roy. Soc., xxx, 1879-80, pp. 162-3. Read February 5, 1880. Sci. Mem., iv, xxiii, p. 393).

2. "On the Cranial and Dental Characters of the Canidæ" (Proc. Zool. Soc., 1880, pp. 238-88. Read April 6, 1880. Sci. Mem., iv, xxv, p. 404).

To these must be added:—

3. "On the Application of the Laws of Evolution to the arrangement of the Vertebrata, and more particularly of the Mammalia" (op. cit., pp. 649-62. Read December 14, 1880. Sci. Mem., iv, xxvi, p. 457). In this memoir stress is laid upon the guiding principles of excess and defect of development, and it is proposed to divide Mammals into four groups, *i.e.*, Eutheria (higher forms), Metatheria (pouched mammals), Prototheria (duck-mole and spiny ant-eater), and Hypotheria (hypothetical primitive types).

1881.

At the beginning of 1881 Huxley was appointed to the Inspectorship of Fisheries (salary £700), rendered vacant by the death of Frank Buckland, and in October his status at South Kensington underwent some alteration. For the Royal School of Mines and Normal School were united, and instead of being Lecturer on General Natural History to the former, he became Professor of Biology in and Dean of the new combination (salary £800). His work as Dean should have been remunerated by an extra £200, but a thrifty Government saved this by special arrangement. At the same time, the long-standing connection with the Geological Survey practically, though not nominally, came to an end.

Huxley's qualifications for the Inspectorship were, of course, unquestionable, and his activity in that direction is summarized in an account given by Sir Spencer Walpole to Mr. Leonard Huxley (Life, ii, pp. 22-7), which

also includes a personal estimate. From this the following quotations are taken :—

“ This protracted investigation [*i.e.*, of the Scotch Herring Commission (1862), and the Sea Fisheries Commission (1864-5)], had convinced Professor Huxley that the supply of fish in the deep sea was practically inexhaustible, and that, however much it might be necessary to enforce the police of the seas by protecting particular classes of sea fishermen from injury done to their instruments by the operations of other classes, the primary duty of the legislature was to develop sea fishing, and not to place restrictions on sea fishermen for any fears of an exhaustion of fish.

“ His scientific training, moreover, made him ridicule the modern notion that it was possible to stock the sea by artificial methods. He was not, however, equally certain that particular areas of sea shore might not be exhausted by our fishing. . . . If, however, Professor Huxley was strongly opposed to unnecessary interference with the labours of sea fishermen, he was well aware of the necessity of protecting migratory fish, like salmon, against over-fishing. . . .

“ It is needless to say that, as a companion, Professor Huxley was the most delightful of men. Those who have met him in society, or enjoyed the hospitality of his house, must have been conscious of the singular charm of a conversation, which was founded on knowledge, enlarged by memory, and brightened by humour. . . . In conversation Professor Huxley displayed the quality which distinguished him both as a writer and a public speaker. He invariably used the right words in the right sense. . . .

“ No one could have known Professor Huxley intimately without recognising that he delighted in combat. He was never happier than when he was engaged in argument or controversy, and he loved to select antagonists worthy of his steel. . . . If, however, a love of argument and controversy occasionally led him into hot water, I do not think that his polemical tendencies ever cost him a friend. His antagonists must have recognised the fairness of his methods, and must have been susceptible to the charm of the man. The high example which he set in controversy, moreover, was equally visible in his ordinary life. Of all the men I have ever known, his ideas and his standard were, on the whole, the highest. He recognised that the fact of his

religious views imposed on him the duty of living the most upright of lives, and I am very much of the opinion of a little child, now grown into an accomplished woman, who, when she was told that Professor Huxley had no hope of future rewards, and no fear of future punishments, emphatically declared: 'Then I think Professor Huxley is the best man I have ever known.'

The recognition accorded by Cambridge during the preceding year was now followed by still more decided marks of appreciation from Oxford. For not only was Huxley asked if he would stand for the Linacre Professorship in succession to Rolleston, but also whether he would consent to be nominated for the Mastership of University College. In both cases the reply was in the negative, for to say nothing of the pecuniary loss involved, and his reluctance to quit London, with its absolute freedom, Huxley doubted whether the "psychical atmosphere of Oxford" would suit him, and thought he was not "cut out for a Don."

An earlier event of the year was the death of Carlyle (in February), whose influence upon Huxley has already been mentioned (*cf.* p. 3). A direct acknowledgment of this is to be found in a letter (dated March 9), to Lord Stanley of Alderley, in answer to one asking him to support the movement for a Carlyle Memorial:—

"Anything I can do to help in raising a memorial to Carlyle shall be most willingly done. Few men can have dissented more strongly from his way of looking at things than I, but I should not yield to the most devoted of his followers in gratitude for the bracing wholesome influence of his writings when, as a very young man, I was essaying without rudder or compass to strike out a course for myself" (*Life*, ii, p. 34).

A National Fishery Exhibition was held at Norwich in the spring, and here (on April 21), he delivered a lecture on "The Herring" (*Nature*, xxiii, 1881, pp. 607-13.

Sci. Mem., iv, xxvii, p. 473). In this the impossibility of exhausting the supply by human agency is pointed out.

Part of the interest of the year has relation to medicine, for Huxley was appointed a member of the Royal Commission on the Medical Acts (the work of which was completed in 1882), and also lectured (on August 9) to the International Medical Congress in London on "The Connection of the Biological Sciences with Medicine" (*Nature*, xxiv, 1881, pp. 342-6. *Sci. Mem.*, iv, xxviii, p. 493. *Coll. Essays*, iii, p. 347). In this a sketch is given of the rise of medicine from crude beginnings to the position of a science, and pathology is claimed as a branch of biology, this having been recognized after the establishment of the cell theory. Modern physiology, upon which pathology depends, begins with Descartes:—

"There can be no question, then, as to the nature or the value of the connection between medicine and the biological sciences. There can be no doubt that the future of pathology and of therapeutics, and, therefore, that of practical medicine, depends upon the extent to which those who occupy themselves with those subjects are trained in the methods and impregnated with the fundamental truths of biology."

It is suggested that no more important subject could be considered by the Congress, than how best, without including useless details, the medical student,—

"... may be enabled to obtain a firm grasp of the great truths respecting animal and vegetable life, without which, notwithstanding all the progress of scientific medicine, he will still find himself an empiric."

The British Association was held at York this summer, and Huxley chose a historical subject on which to lecture, "The Rise and Progress of Palæontology" (*Nature*, xxiv,

1881, pp. 452-5. *Sci. Mem.*, iv, xxix, p. 508. *Coll. Essays*, iv, p. 24). This sketches the history of the subject, and ends as follows :—

“ I have always had a certain horror of presuming to set a limit upon the possibilities of things. Therefore I will not venture to say that it is impossible that the multitudinous species of animals and plants may have been produced, one separately from the other, by spontaneous generation ; nor that it is impossible that they should have been independently originated by an endless succession of miraculous creative acts. But I must confess that both these hypotheses strike me as so astoundingly improbable, so devoid of a shred of either scientific or traditional support, that even if there were no other evidence than that of palæontology in its favour, I should feel compelled to adopt the hypothesis of evolution. Happily, the future of palæontology is independent of all hypothetical considerations. Fifty years hence, whoever undertakes to record the progress of palæontology will note the present time as the epoch in which the law of succession of the forms of the higher animals was determined by the observation of palæontological facts. He will point out that, just as Steno and Cuvier were enabled from their knowledge of the empirical laws of co-existence of the parts of animals to conclude from a part to the whole, so the knowledge of the law of succession of forms empowered their successors to conclude, from one or two terms of such a succession, to the entire series ; and thus to divine the existence of forms of life, of which, perhaps, no trace remains, at epochs of inconceivable remoteness in the past.”

At the end of the year we unfortunately find a record of bad health, but not enough to completely stop work, nor amounting to a complete breakdown.

1882.

The deaths of Charles Darwin and Francis Maitland Balfour in 1882, were both felt by Huxley as heavy personal losses. The former event took place on April 19, and a short notice by Huxley appeared in

Nature on the 27th (Coll. Essays, ii, p. 244). The obituary notice for that periodical was undertaken by Romanes, who submitted the draft to Huxley for criticism. One paragraph in the answering letter (dated May 9), compares Darwin with other epoch-making naturalists :—

“I am not likely to take a low view of Darwin’s position in the history of science, but I am disposed to think that Buffon and Lamarck would run him hard in both genius and fertility. In breadth of view and in extent of knowledge these two men were giants, though we are apt to forget their services. Von Baer was another man of the same stamp; Cuvier, in a somewhat lower rank, another; and J. Müller another” (Life, ii, p. 39).

Later on (June 9, 1885), Huxley paid a tribute to Darwin’s memory when, in the capacity of President of the Royal Society, he handed over a statue to H.R.H. the Prince of Wales, as representing the Trustees of the British Museum (Coll. Essays, ii, p. 248). And, finally, he wrote the somewhat belated *Obituary Notice* for the Royal Society (Proc. Roy. Soc., xlv, 1888. Coll. Essays, ii, p. 253). These, together with other utterances and writings, enable us to form a just notion of Huxley’s views regarding Darwin and his work. For example, the peroration to the speech on the occasion of unveiling Darwin’s statue runs thus :—

“We do not make this request [*i.e.*, acceptance of the statue] for the mere sake of perpetuating a memory; for so long as men occupy themselves with the pursuit of truth, the name of Darwin runs no more risk of oblivion than does that of Copernicus, or that of Harvey.

“Nor, most assuredly, do we ask you to preserve the statue in its cynosural position in this entrance hall of our National Museum of Natural History as evidence that Mr. Darwin’s views have received your official sanction; for science does not recognise such sanctions, and commits suicide when it adopts a creed.

“No, we beg you to cherish this memorial as a symbol by

which, as generation after generation of students enter yonder door, they shall be reminded of the ideal according to which they must shape their lives, if they would turn to the best account the opportunities offered by the great institution under your charge."

An allusion to Darwin's scientific position in England is also contained in a letter to the Bishop of Ripon (dated June 16, 1887:—

"Of deceased Englishmen who belong to the first half of the Victorian epoch, I should say that Faraday, Lyell, and Darwin had exerted the greatest influence, and all three were models of the highest and best class of physical philosophers" (Life, ii, p. 162).

Huxley was awarded the Darwin Medal in 1894, and in his eloquent speech delivered at the Anniversary dinner of the Society, on St. Andrew's Day, gave an account of his long association with Darwin, and the part he played in defending and promulgating Darwinism. The speech included the following passage, which summarizes the characteristics and methods of Darwin in a way it would be difficult to surpass:—

"Those who wish to attain to some clear and definite solution of the great problems which Mr. Darwin was the first person to set before us in later times must base themselves upon the facts which are stated in his great work, and, still more, must pursue their inquiries by the methods of which he was so brilliant an exemplar throughout the whole of his life. You must have his sagacity, his untiring search after the knowledge of fact, his readiness always to give up a preconceived opinion to that which was demonstrably true, before you can hope to carry his doctrines to their ultimate issue; and whether the particular form in which he has put them before us may be such as is finally destined to survive or not is more, I venture to think, than anybody is capable at this present moment of saying. But this one thing is perfectly certain—that it is only by pursuing his methods, by that wonderful single-mindedness, devotion to truth, readiness to sacrifice all things for the advance of definite knowledge, that we can hope

to come any nearer than we are at present to the truths which he struggled to attain (*Life*, ii, p. 390. Extracted from the *Times* report).

While Darwin died full of years as well as honours, the career of Francis Maitland Balfour, Professor of Comparative Morphology at Cambridge, was cut short at the age of thirty-one by a fall from the Aiguille Blanche on Mont Blanc. With a scientific reputation second to none, won more particularly in the department of comparative embryology, many regarded Balfour as the most likely zoologist to continue Huxley's work. In a letter to Dohrn, dated September 24, 1882, Huxley himself remarks :—

“ Heavy blows have fallen upon me this year in losing Darwin and Balfour, the best of the old and the best of the young. I am beginning to feel older than my age myself, and if Balfour had lived I should have cleared out of the way as soon as possible, feeling that the future of Zoological Science in this country was very safe in his hands ” (*Life*, ii, p. 38).

And Mr. Leonard Huxley says :—

“ Since the death of Edward Forbes, no loss outside the circle of his family had affected my father so deeply. For three days he was utterly prostrated, and was scarcely able either to eat or sleep ” (*Life*, ii, p. 37).

Turning now to the utterances on education for the year, we find an address “ On Science and Art in Relation to Education,” given to the members of the Liverpool Institution (*Coll. Essays*, iii, p. 160). This “ Hansardises ” an address previously given to the Liverpool Philomathic Society (*cf.* p. 90), and disclaims any intention to promote the sweeping away of all forms of culture and instruction except those of physical science :—

“ I have never yet met with any branch of human knowledge

which I have found unattractive—which it would not have been pleasant to me to follow, so far as I could go; and I have yet to meet with any form of art in which it has not been possible for me to take as acute a pleasure as, I believe, it is possible for most to take.”

In allusion to his wide experience of races and castes he says :—

“And I have never found, in any of these conditions of life, a deficiency of something which was attractive. Savagery has its pleasures, I assure you, as well as civilization, and I may even venture to confess—if you will not let a whisper of the matter get back to London, where I am known—I am even fain to confess, that sometimes in the din and throng of what is called ‘a brilliant reception,’ the vision crosses my mind of waking up from the soft plank which had afforded me satisfactory sleep during the hours of night, in the bright dawn of a tropical morning, when my comrades were yet asleep, when every sound was hushed, except the little lap-lap of the ripples against the sides of the boat, and the distant twitter of the sea-bird on the reef. And when that vision crosses my mind, I am free to confess I desire to be back in the boat again.”

His previous opinions about the educational value of physical science are reaffirmed, given a proper selection of topics, practical teaching, practical teachers, and a sufficiency of time. Otherwise the subject is best left alone :—

“The whole object of education is, in the first place, to train the faculties of the young in such a manner as to give their possessors the best chance of being happy and useful in their generation; and, in the second place, to furnish them with the most important portions of that immense capitalized experience of the human race which we call knowledge of various kinds.”

Education should involve reasoning and feeling, intellectual exercise and æsthetic training, in other words both Science and Art, though between these there is no

sharp boundary. The subjects taken should include,—reading and writing, drawing, the elements of physical science, of morals, of politics and of sociology; also English History (with incidental geography) taught in a rational way.

As to the æsthetic side, using the English language as an instrument :—

“If a man cannot get literary culture of the highest kind out of his Bible, and Chaucer, and Shakespeare, and Milton, and Hobbes, and Bishop Berkeley, to mention only a few of our illustrious writers—I say, if he cannot get it out of those writers, he cannot get it out of anything.”

Pupils should also be taught to use English, “with precision, with force, and with art.” Translations of classical works might well be read. Music or painting should be reserved for children of special faculty :—

“With that outfit, an Englishman, within the limits of English life, is fitted to go anywhere, to occupy the highest positions, to fill the highest offices of State, and to become distinguished in practical pursuits, in science, or in art.”

Latin and German are mentioned as desirable additions, should the limitations of time permit.

Beyond the essential and eminently desirable subjects, let each take up some special line which appeals more particularly to him.

The Medical Acts Commission, of which the object was to suggest how best to adjust the numerous possible qualifications, reported this year. It recommended Divisional Boards for the three Kingdoms, which would be concerned with the registration and final examination of students, successful candidates for the latter to be licensed by the General Medical Council, to be elected by the Boards themselves. No provision made for the

appointment of external examiners. Existing bodies suffering pecuniary loss by the new arrangement to be compensated.

Huxley signed the majority report, but also submitted a separate report of his own, based on the practice in Scotland, and proposing :—

“ . . . that if any examining body satisfies the Medical Council (or other State authority) that it requires full and efficient instruction and examination in the three branches of medicine, surgery, and midwifery ; and if it admits a certain number of coadjutor examiners appointed by the State authority, the certificate of that authority shall give admission to the Medical Register ” (Life, ii, p. 41).

The Bill, brought in (1882) with the view of carrying out the ideas expressed in the Report, was defeated.

Two years later he explained his views in detail in the opening Address of the London Hospital Medical School on “ The State and the Medical Profession ” (Coll. Essays, iii, p. 323). In this he objects to repressive measures, and trades unionism in medicine, and thinks ‘ over the counter ’ practice ought to be permitted. The State must legislate for death certificates, expert witnesses, and government posts.

It is pointed out that forty years previously there were no less than twenty-one ways of obtaining a medical qualification, including license by the Archbishop of Canterbury. Improvements were effected by the University of London, and by the Medical Act of 1858, which instituted a Medical Registrar and a Medical Council. The methods of the Scottish Universities, especially Edinburgh, are described. At the time of the address (1884) the licensing bodies had been reduced to nineteen, by retirement of the Primate, and union of two other authorities. Two or three black sheep remained.

The main report of the Commission and Huxley's own minority report are explained, and exception taken to the idea of compensation contained in the former. This would mean penalizing the competent bodies and perpetually endowing the "black sheep" to an amount "calculated on the maximum of their ill-gained profits."

The address advocated an extension of curriculum, centralizing the instruction given in the earlier part of the student's course, and the endowment of medical research.

Three scientific memoirs bear date 1882 :—

1. "A Contribution to the Pathology of the Epidemic known as the 'Salmon Disease'" (Proc. Roy. Soc., xxxiii, 1882, pp. 381-9. Read March 2, 1882. Sci. Mem., iv, xxx, p. 520).

2. "On Saprolegnia in relation to the Salmon Disease" (Q. J. Micros. Sci., New Ser., xxii, 1882, pp. 311-33 : extracted from the twenty-first Annual Report of H.M.'s Inspectors of Sea Fisheries. Sci. Mem., iv, xxxii, p. 540).—This and the preceding were the result of much patient work carried out by Huxley in his capacity as a Fishery Inspector. Saprolegnia is a parasitic fungus, a species of which attacks the skin of the salmon, causing sore patches.

3. "On the Respiratory Organs of Apteryx" (Proc. Zool. Soc., 1882, pp. 560-9. Read June 20, 1882. Sci. Mem., iv, xxxi, p. 529).—Apteryx is the scientific name for the "kiwi," the smallest existing species of running bird, indigenous to New Zealand.

1883.

The death of Spottiswoode in June of this year made the first break in the α Club, which had existed for

eighteen years, and left the Presidency of the Royal Society vacant. Huxley, who had been Secretary for nine years (1872-81), was by no means anxious for the office, but his election took place almost as a matter of course, and the many hearty congratulations which followed gave even more pleasure than the honour conferred. One characteristic reason for acceptance is given in a letter (dated July 8) to the Warden of Merton College, Oxford:—

“ . . . I may say that I accepted the office *inter alia* for the purpose of getting people to believe that such places may be properly held by people who have neither riches nor station—who want nothing that statesmen can give—and who care for nothing except upholding the dignity and the freedom of science ” (Life, ii, p. 52).

And, similarly, in a letter to Sir W. H. Flower (dated July 7):—

“ I will not, if I can help it, allow the chair of the Royal Society to become the appanage of rich men, or have the noble old Society exploited by enterprising commercial gents who make their profit out of the application of science ” (loc. cit).

The amount of scientific research accomplished had for some time been steadily diminishing, while other kinds of work rapidly increased, until breaking strain was reached, not, however, till the following year. A large part of the interests and duties for 1883 are connected with fisheries. A Friday Evening Discourse on “ Oysters and the Oyster Question ” was delivered at the Royal Institution on May 11 (published with additions in The English Illustrated Magazine, 1883-4, pp. 47-55, 112-21. Sci. Mem., iv, xxxiv, p. 572), and the winter lectures to working-men (January 8–February 12) were on the same topic.

The single scientific memoir for the year is an important addition to our knowledge of fishes :—"Contributions to Morphology. Ichthyopsida.—No. 2. On the Oviducts of *Osmerus* [the smelt]; with Remarks on the Relations of the Teleostean with the Ganoid Fishes" (Proc. Zool. Soc., 1883, pp. 132-9. Read March 20, 1883. Sci. Mem., iv, xxxiii, p. 563).

The Fisheries Exhibition held in London during 1883 involved a large amount of work of various kinds, including the "Inaugural Address" on behalf of the Commissioners, in response to a welcome given by H.R.H. the Prince of Wales (Fisheries Exhibition Literature, iv, 1885, pp. 3-22. Delivered June 18, 1883. Sci. Mem., Supply. Vol., v, p. 80). In this some of the views regarding fish-supply already mentioned (*cf.* p. 160) are reiterated.

A further mark of appreciation on the part of the University of Cambridge took place this summer, for Huxley delivered the Rede Lecture on June 12, taking "Evolution, as illustrated by the Pearly Nautilus," for his subject (Nature, xxviii, 1883, pp. 187-9. Sci. Mem., Supply. Vol., iv, p. 69). To one familiar with his appearance and manner only four years previously the marked ageing and comparative feebleness were painfully apparent. Later in the summer, however (Life, ii, p. 58), his health is said to have been unusually good, giving no hint of the complete breakdown so soon to take place.

An amusing incident took place at Cambridge when Huxley was up for the Rede Lecture, in connection with the conferring of honorary degrees upon a large number of celebrities, including Matthew Arnold, Sir Richard Temple, and Lubbock. Huxley, enveloped in his red gown, sat near the front with the other doctors. There

had recently been a skirmish of pens between him and Arnold, and when the latter advanced to stand out the usual oration, an irreverent undergraduate shouted from the gallery—"Go and shake hands with Huxley!" The joke was small, but Huxley's semi-amused, semi-sarcastic expression was great.

CHAPTER XVI

BREAKDOWN AND RETIREMENT—CRITICAL THEOLOGY [1884-86].

DYSPEPSIA and hypochondria during 1884 made life a burden, though the correspondence of this time contains many flashes of humour. Among other annoyances, Huxley had to submit to the extraction of all his remaining teeth, and this greatly depressed him, for his zoological studies had led to the conviction that the end of the dentition meant the end of the animal.

Some improvement was effected by a trip to Cornwall and Wales in the second half of the summer, but at the end of this he was imperatively ordered to go abroad for some months, Italy being chosen as the country to be visited. Unfortunately, family trouble added to the burden of physical disability, for while arrangements were being made for the marriage of his third daughter, his second one (Mrs. Collier) was prostrated with serious illness, which left little hope of ultimate recovery.

Some of the impressions of Italy are interesting. Thus in a letter written from Lugano to Sir Michael Foster :—

“ Venice itself just suited me. I chartered a capital gondolier, and spent most of my time exploring the Lagoons. Especially I paid a daily visit to the Lido, and filled my lungs with the sea air, and rejoiced in the absence of stinks. For Venice is like her population (at least the male part of it), handsome but odorous. Did you notice how handsome the young men are and how little beauty there is among the women? . . . Verona

delighted me more than anything I have seen. . . ." (Life, ii, p. 81).

And in a letter from Naples to Sir John Evans (dated December 10):—

"In spite of snow on the ground we had three or four days at Ravenna—which is the most interesting deadly lively sepulchre of a place I was ever in in my life. The evolution of modern from ancient art is all there in a nutshell. . . ." (Life, ii, p. 85).

Of Rome, to a daughter (January 11, 1885):—

"Since the time of Constantine there has been nothing but tawdry rubbish in the shape of architecture—the hopeless bad taste of the Papists is a source of continual gratification to me as a good Protestant (and something more). . . . But down to the time of Constantine, Rome is endlessly interesting, and if I were well I should like to spend some months in exploring it. As it is, I do very little, though I have contrived to pick up all I want to know about Pagan Rome and the Catacombs, which last are my especial weakness" (Life, ii, p. 88).

And again, to his eldest son (January 20, 1885):—

"I need hardly tell you that I find Rome wonderfully interesting, and the attraction increases the longer one stays. I am obliged to take care of myself and do but little in the way of sight-seeing, but by directing one's attention to particular objects one can learn a great deal without much trouble. I begin to understand Old Rome pretty well, and I am quite learned in the Catacombs, which suit me, as a kind of Christian fossils out of which one can reconstruct the body of the primitive Church. She was a simple maiden enough and vastly more attractive than the bedizened old harridan of the modern Papacy, so smothered under the old clothes of Paganism which she has been appropriating for the last fifteen centuries that Jesus of Nazareth would not know her if he met her" (Life, ii, p. 91).

In the last quotation we find the beginning of a new subject, critical theology, to which, along with philo-

sophy and sociology Huxley devoted most of his last ten years of life. Dissection, and particularly microscopic work, involved such physical discomfort that they had to be practically abandoned.

1885.

Despite his precarious health, he took a keen interest in current events, and was deeply grieved to hear of the death of General Gordon, of whom he thus speaks in a letter to Sir John Donnelly (dated February 16):—

“Poor fellow! I wonder if he has entered upon the ‘larger sphere of action’ which he told me was reserved for him in case of such a trifling accident as death. Of all the people whom I have met with in my life, he and Darwin are the two in whom I have found something bigger than ordinary humanity—an unequalled simplicity and directness of purpose—a sublime unselfishness.

“Horrible as it is to us, I imagine that the manner of his death was not unwelcome to himself. Better wear out than rust out, and better break than wear out. The pity is that he could not know the feeling of his countrymen about him.

“I shall be curious to see what defence the superingenious Premier has to offer for himself in Parliament. I suppose, as usual, the question will drift into a brutal party fight, when the furious imbecility of the Tories will lead them to spoil their case. That is where we are; on the one side, timid imbecility ‘waiting for instructions from the constituencies’; furious imbecility on the other, looking out for party advantage. Oh! for a few months of William Pitt” (Life, ii, pp. 94-5).

The Italian visit was extended into late spring, but the result was only a modified success. Venice, Rome, Naples and Florence had all proved more or less unsatisfactory; most benefit being apparently derived at Siena, allusion to which is made in a letter to his youngest daughter (dated February 23, 1885):—

“The change here is wonderfully to the good. We are perched more than a thousand feet above the sea, looking over the Tuscan hills for twenty or thirty miles every way. It is warm enough to sit with the window wide open and yet the air is purer and more bracing than in any place we have visited. . . . Then there is one of the most wonderful cathedrals to be seen in all North Italy—free from all gaudy finery and atrocious bad taste which have afflicted me all over South Italy. The town is the quaintest place imaginable—built of narrow streets on several steep hills to start with, and then apparently stirred up with a poker to prevent monotony of effect” (*Life*, ii, p. 96).

Huxley was back in England on April 8, and being ordered by Sir Andrew Clark to give up all serious work, resigned his Professorship and Fishery Inspectorship in May, immediately after his sixtieth birthday. At this age he had been wont to declare men of science ought to be strangled! It was, however, arranged that he should retain the title of Professor of Biology, and asked to undertake some general superintendence at the Royal College of Science, in the capacity of Honorary Dean. The work of the chair was divided into botanical and zoological moieties, entrusted to two assistant Professors, D. W. Scott and G. B. Howes. The untiring devotion of the latter, first as Demonstrator, and later as Deputy Professor during Huxley's illness, had prevented any serious hitches in the course for which the latter was responsible as Professor.

Huxley's retiring allowances, after thirty-one years' Government service, were fixed at £1200 per annum, and to this a Civil List Pension of £300 was added later in the year, on the initiative of Lord Iddesleigh. Retirement, therefore, meant no loss of official income.

In reply (November 24, 1885) to Lord Iddesleigh's letter, the Pension was accepted in the following terms:—

“With respect to your Lordship's offer to submit my name

to Her Majesty for a Civil List Pension, I can but accept a proposal which is in itself an honour, and which is rendered extremely gratifying to me by the great kindness of the expressions in which you have been pleased to embody it" (Life, ii, p. 108).

An even bigger wrench was involved in the resignation of the Presidency of the Royal Society on November 30, the reasons for the step being given as follows in his last Presidential address :—

"I am happy to say that I have good reason to believe that, with prolonged rest—by which I do not mean idleness, but release from distraction and complete freedom from those lethal agencies which are commonly known as the pleasures of society—I may yet regain so much strength as is compatible with advancing years. But in order to do so, I must, for a long time yet, be content to lead a more or less anachoretic life. Now it is not fitting that your President should be a hermit, and it becomes me, who have received so much kindness and consideration from the Society, to be particularly careful that no sense of personal gratification should delude me into holding the office of its representative one moment after reason and conscience have pointed out my incapacity to discharge the serious duties which devolve upon the President, with some approach to efficiency.

"I beg leave, therefore, with much gratitude for the crowning honour of my life which you have conferred upon me, to be permitted to vacate the chair of the Society as soon as the business of this meeting is at an end" (Life, ii, p. 107).

Two other events for 1885 still require mention. One, in May, was the conferment of the degree of D.C.L. (*honoris causâ*) by the University of Oxford. In answering the letter inviting him to accept this honour, he wrote :—

"It will be a sort of apotheosis coincident with my official death, which is imminent. In fact, I am dead already, only the Treasury Charon has not yet settled the conditions upon which I am to be ferried over to the other side" (Life, ii, p. 110).

The second event was the unveiling of the Darwin statue (June 9), and its formal presentation to the Trustees of the British Museum (*cf.* p. 164).

A gradual improvement of health followed resignation, and the early stage of a somewhat acrimonious controversy with Mr. Gladstone towards the end of the year seems to have proved a very effective pick-me-up. In the November number of the *Nineteenth Century* Gladstone in his article "The Dawn of Creation and Worship," had traversed the views expressed by Dr. Réville in his *Prolegomena to the History of Religions*, and tried to show that the order of creation given in the first chapter of Genesis is in harmony with the conclusions of science.

Huxley's reply appeared in the December number of the same periodical, and was entitled "The Interpreters of Genesis and the Interpreters of Nature" (Coll. Essays, iv, p. 139). It sets forth in detail the untenability of Gladstone's position, and concludes with remarks on the general question of Science *versus* Religion:—

"The antagonism between science and religion, about which we hear so much, appears to me to be purely factitious—fabricated, on the one hand, by short-sighted religious people who confound a certain branch of science, theology, with religion; and, on the other, by equally short-sighted scientific people who forget that science takes for its province only that which is susceptible of clear intellectual comprehension; and that, outside the boundaries of that province, they must be content with imagination, with hope, and with ignorance. . . .

"The antagonism of science is not to religion, but to the heathen survivals and the bad philosophy under which religion herself is often well-nigh crushed. And, for my part, I trust that this antagonism will never cease; but that, to the end of time, true science will continue to fulfil one of her most beneficent functions, that of relieving men from the burden of false science which is imposed upon them in the name of religion."

The stimulating effect of Gladstone's article will be gathered from the following extract taken from a letter to Lord Farrer (dated December 6, 1885):—

“From a scientific point of view Gladstone's article was undoubtedly not worth powder and shot. But, on personal grounds, the perusal of it sent me blaspheming about the house with the first healthy expression of wrath known for a couple of years—to my wife's great alarm—and I should have ‘busted up’ if I had not given vent to my indignation; and secondly, all orthodoxy was gloating over the slap in the face which the G.O.M. had administered to science in the person of Réville” (Life, ii, p. 115).

Mr. Gladstone's reply—“Proem to Genesis”—appeared in the January (1886) number of the *Nineteenth Century*, and Huxley's rejoinder—“Mr. Gladstone and Genesis”—in that for February (Coll. Essays, iv, p. 164). This is sufficiently scathing, although it was subjected to a good deal of pruning before publication, at the request of the editor. The passage about reptiles, the inconveniently early geological appearance of which does not harmonize with the “order” in Genesis, is terribly sarcastic:—

“Still, the wretched creatures stand there, impudently demanding notice; and, however different may be the practice in that contentious atmosphere with which Mr. Gladstone expresses and laments his familiarity, in the atmosphere of science it really is of no avail whatever to shut one's eyes to facts, or to try to bury them out of sight under a tumulus of rhetoric. That is my experience of the ‘Elysian regions of Science,’ wherein it is a pleasure to me to think that a man of Mr. Gladstone's intimate knowledge of English life, during the last quarter of a century, believes my philosophic existence to have been rounded off in unbroken equanimity.”

And apropos of the difference between a lecture and a sermon:—

“I note, incidentally, that Mr. Gladstone appears to consider

the *differentia* between a lecture and a sermon is, that the former, so far as it deals with matters of fact, may be taken seriously, as meaning exactly what it says, while a sermon may not. I have quite enough on my hands without taking up the cudgels for the clergy, who will probably find Mr. Gladstone's definition unflattering."

The controversy above alluded to excited a very widespread interest, as sufficiently attested by a great variety of letters that made their appearance in the *Times*. The clerical party, many years previously, had done their best to discredit the theory of evolution, and now having plenty of time for the congenial task, Huxley vigorously assaulted the enemy's camp.

1886.

More than half this year was marred by constantly recurring attacks of illness, but temporary rejuvenescence was effected by an August spent at Arolla (canton Valais), 6000 feet above the sea, while both earlier and later in the year Ilkley proved remarkably beneficial. One result of the improvement effected by the Swiss mountain air was a return to scientific research, this time of botanical nature, a careful study being made of the gentians.

Apart from this and the literary work to be presently mentioned, retirement by no means meant rusting out:—

"Examinations—for the last time, however—the meetings of the Eton Governing body, the business of the Science Schools, the Senate of the London University, the Marine Biological Association, the Council of the Royal Society, and a round dozen of subsidiary committees, all claimed his attention. Even when driven out of town by his bad health he would come up for a few days at a time to attend necessary meetings" (Life, ii, p. 121).

Huxley was President of the Marine Biological Association, which early in the year was considering the advisability of trying to induce the Government to add a scientific adviser to the Board of Fisheries. He opposed the step, being of opinion it would lead to administrative difficulties.

In his capacity as a Governor of Eton he had to take part in the election of a new head, and some of his ideas about what ought to be done are embodied in a letter to his eldest son (dated July 6):—

“The whole system of paying the Eton masters by the profits of the boarding-houses they keep is detestable to my mind, but any attempt to alter it would be fatal. . . . I look to the new appointment with great anxiety. It will make or mar Eton. If the new Headmaster has the capacity to grasp the fact that the world has altered a good deal since the Eton system was invented, and if he has the sense to adapt Eton to the new state of things, without letting go that which was good in the old system, Eton may become the finest public school in the country. If on the contrary he is merely a vigorous representative of the old system pure and simple, the school will go to the dogs” (Life, ii, pp. 134-5).

As a strong Unionist, Huxley was of course intensely interested in the Home Rule question which was agitating the country at this time, and his views are expressed in a letter to Mr. Albert Grey, M.P. (dated March 21, 1886), published in the *Times* for April 13, under somewhat singular circumstances. It appears that the Unionist case had not been adequately stated in America, and contributions to the Nationalist funds had been coming over the water somewhat more freely than the other party relished. Mr. Grey, therefore, arranged to cable to an American newspaper syndicate the opinions of leading Unionists, and from America came the suggestion that the series should begin with Huxley. It

would be difficult to find a more direct proof than this of the authority which attached in the States to his views.

In the letter under discussion it will be seen that he declined to make the statement desired, but he afterwards consented to publication of the letter itself:—

“ I am as much opposed to the Home Rule Scheme as any one can possibly be, and if I were a political man I would fight against it as long as I had any breath left in me; but I have carefully kept out of the political field all my life, and it is too late for me now to think of entering it.

“ Anxious watching of the course of affairs for many years past has persuaded me that nothing short of some sharp and sweeping national misfortune will convince the majority of our countrymen that government by average opinion is merely a circuitous method of going to the devil; and that those who profess to lead but in fact slavishly follow this average opinion, are simply the fastest runners and the loudest squeakers of the herd, which is rushing blindly down to its destruction.

“ It is the electorate, and especially the Liberal electorate, which is responsible for the present state of things. It has no political education. It knows well enough that two and two won't make five in a ledger, and that sentimental stealing in private life is not to be tolerated; but it has not been taught the great lesson in history that there are like verities in national life, and hence it easily falls a prey to any clever and copious fallacy-monger who appeals to its great heart instead of reminding it of its weak head.

“ Politicians have gone on flattering and cajoling this chaos of political incompetence until the just penalty of believing their own fictions has befallen them, and the average Member of Parliament is conscientiously convinced that it is his duty, not to act for his constituents to the best of his judgment, but to do exactly what they, or rather the small minority which drives them, tells him to do.

“ Have we a real statesman, a man of the calibre of Pitt or Burke, to say nothing of Strafford or Pym, who will stand up and tell his countrymen that this disruption of the union is nothing but a cowardly wickedness—an act bad in itself, fraught

with immeasurable evil—especially to the people of Ireland ; and that if it cost his political existence, or his head, for that matter, he is prepared to take any and every honest man's means of preventing the mischief ?

“ I see no sign of any. And if such a man should come to the front, what chance is there of his receiving loyal and continuous support from a majority of the House of Commons ? I see no sign of any.

“ There was a time when the political madness of one party was sure to be checked by the sanity, or at any rate the jealousy, of the other. At the last election I should have voted for the Conservatives (for the first time in my life), had it not been for Lord Randolph Churchill ; but I thought that by thus jumping out of the Gladstonian frying-pan into the Churchillian fire, I should not mend matters, so I abstained altogether.

“ Mr. Parnell has great qualities. For the first time the Irish malcontents have a leader who is not eloquent, but who is honest ; who knows what he wants and faces the risks involved in getting it. Our poor Right Honourable Rhetoricians are no match for this man who understands realities. I believe also that Mr. Parnell's success will destroy the English politicians who permit themselves to be his instruments, as soon as bitter experience of the consequences has brought Englishmen and Scotchmen (and I will add Irishmen) to their senses.

“ I suppose one ought not to be sorry for that result, but there are men among them over whose fall all will lament ” (Times, loc. cit. Life, ii, pp. 124-6).

Besides the second Genesis paper, the year's work included an article for an American periodical (The Youth's Companion), and two important essays. The article, entitled “ From the Hut to the Pantheon ” is a study in architectural evolution, the point of departure being the prehistoric beehive hut. Since one of the two essays, “ The Evolution of Theology : an Anthropological Study,” which appeared in the *Nineteenth Century* for March and April 1886, and the counterblasts to Gladstone, made up an important part of the fourth volume of the *Collected Essays* (“ Science and Hebrew

Tradition”), it may be well first of all to deal with the introduction to this, notwithstanding it was written some years subsequently, being dated October 9, 1893.

The purpose of this introduction is to advance the claims of the higher criticism to serious consideration, as against the doctrine of biblical infallibility :—

“ It is becoming, if it has not become, impossible for men of clear intellect and adequate instruction to believe, and it has ceased, or is ceasing, to be possible for such men honestly to say they believe, that the universe came into being in the fashion described in the first chapter of Genesis ; or to accept, as a literal truth, the story of the making of woman, with the account of the catastrophe which followed hard upon it, in the second chapter ; or to admit that the earth was re-peopled with terrestrial inhabitants by migration from Armenia or Kurdistan, little more than 4000 years ago, which is implied in the eighth chapter ; or, finally, to shape their conduct in accordance with the conviction that the world is haunted by innumerable demons, who take possession of men and may be driven out of them by exorcistic adjurations, which pervades the Gospels.

“ Nevertheless, if there is any justification for the dogma of plenary inspiration, the damnatory prodigality of even the Athanasian Creed is still too sparing. ‘ Whosoever will be saved,’ must believe, not only all these things, but a great many others of equal repugnancy to common sense and everyday knowledge. . . .

“ For those who look upon ignorance as one of the chief sources of evil ; and hold veracity, not merely in act, but in thought, to be the one condition of true progress, whether moral or intellectual, it is clear that the biblical idol must go the way of all other idols. Of infallibility, in all shapes, lay or clerical, it is needful to iterate with more than Catonic pertinacity, *Delenda est.*”

The Preface also includes a vigorous attack upon those who were responsible for the *Helps to the Study of the Bible* appended to the *Oxford Bible for Teachers* (new

edition, 1893), and which adheres to the old views in regard to the authorship of the Pentateuch :—

“ There is no living biblical scholar who can ignore authorities of the rank of Reuss and Wellhausen, of Robertson Smith, and Kuenen, without gross presumption ; I might even say without raising a serious doubt of his scientific integrity. . . .

“ If I were to publish ‘Helps to the Study of Zoology,’ for popular use, in which the progress of science in the last fifty years was ignored, and every recent authority passed over in silence, I am afraid, and indeed hope, that I should get into great trouble. But to be sure I should be judged by mere lay standards of right and wrong.”

The essay itself (“Evolution of Theology,” Coll. Essays, iv, p. 287) is a study in anthropology, for which the Old Testament furnishes the material :—

“ In this venerable record of ancient life, miscalled a book, when it is really a library comparable to a selection of works from English literature between the times of Beda and those of Milton, we have the stratified deposits (often confused and even with their natural order inverted) left by the stream of the intellectual and moral life of Israel during many centuries. And, embedded in these strata, there are numerous remains of forms of thought which once lived, and which, though often unfortunately mere fragments, are of priceless value to the anthropologist. Our task is to rescue these from their relatively unimportant surroundings, and by careful comparison with existing forms of theology, to make the dead world which they record live again. In other words, our problem is palæontological, and the method pursued must be the same as that employed in dealing with other fossil remains.”

Part of the concluding paragraph runs as follows :—

“ It is my conviction that, with the spread of true scientific culture, whatever may be the medium, historical, philological, philosophical, or physical, through which that culture is conveyed, and with its necessary concomitant, a constant elevation of the standard of veracity, the end of the evolution of theology will be

like its beginning—it will cease to have any relation to ethics. I suppose that, so long as the human mind exists, it will not escape its deep-seated instinct to personify its intellectual conceptions. . . . So, it may be, that the majority of mankind may find the practice of morality made easier by the use of theological symbols. And unless these are converted from symbols into idols, I do not see that science has anything to say to the practice, except to give an occasional warning of its dangers. But, when such symbols are dealt with as real existences, I think the highest duty which is laid upon men of science is to show that these dogmatic idols have no greater value than the fabrications of men's hands, the stocks and the stones, which they have replaced."

The second essay "Science and Morals" (Coll. Essays, ix, p. 117) appeared in the *Fortnightly Review* for November, by way of reply to Mr. W. S. Lilly, who in a previous contribution to that periodical, entitled "Materialism and Morality," impugned the views of W. K. Clifford, Herbert Spencer and Huxley, on account of their supposedly materialistic character.

Huxley's article, as usual, is not only incisive, but includes some fine writing. The relation of Science, the "Cinderella" sister of Philosophy and Theology, to Morals, is admirably summed up in the last two paragraphs:—

"Cinderella is modestly conscious of her ignorance of these high matters. She lights the fire, sweeps the house, and provides the dinner; and is rewarded by being told that she is a base creature, devoted to low and material interests. But in her garret she has fairy visions out of the ken of the pair of shrews who are quarrelling downstairs. She sees the order which pervades the seeming disorder of the world; the great drama of evolution, with its full share of pity and terror, but also with abundant goodness and beauty, unrolls itself before her eyes; and she learns, in her heart of hearts, the lesson, that the foundation of morality is to have done, once and for all, with lying; to give up pretending to believe that for which there is no

evidence, and repeating unintelligible propositions about things beyond the possibility of knowledge.

“She knows that the safety of morality lies neither in the adoption of this or that philosophical speculation, or this or that theological creed, but in a real and living belief in that fixed order of nature which sends social disorganization upon the track of immorality, as surely as it sends physical disease after physical trespasses. And of that firm and lively faith it is her high mission to be the priestess.”

CHAPTER XVII

TECHNICAL EDUCATION—CONTROVERSIAL WRITINGS

[1887].

As during the previous year, ill health interfered with work, and this time a new ailment, pleurisy, made its appearance. But, as before, Swiss air proved itself a sovereign remedy, and two months at Arolla worked wonders. Before the end of the year, however, bereavement once more laid a heavy hand upon him, for on November 19 his second daughter Marian (Mrs. Collier) was rapidly carried off by pneumonia. Though three years' illness preceded this (*cf.* p. 174), so sudden an ending was unexpected.

A large part of the interest of the year centres around technical education, the immediate occasion being the proposals for establishing an Imperial Institute as a Jubilee Memorial. Speaking at the Mansion House Meeting on January 12, Huxley alluded to the original antagonism between pure science and "practical" men, and then proceeded to sketch the gradual alteration which had taken place in this state of things:—

“. . . but within the last thirty years, more particularly, that state of things had entirely changed. There began in the first place a slight flirtation between science and industry, and that flirtation had grown into an intimacy, he might almost say courtship, until those who watched the signs of the times saw that it was high time that the young people married and set up an establishment for themselves. This great scheme, from his point of view, was the public and ceremonial marriage of science

and industry" (*Nature*, xxxiii, 1887, p. 265. *Life*, ii, pp. 150-1).

Part of a letter contributed to the *Times* (January 27) was published by the Committee as admirably expressing the purpose the Institute was meant to fulfil:—

“That with which I did intend to express my strong sympathy, was the intention which I thought I discerned to establish something which should play the same part in regard to the advancement of industrial knowledge which has been played in regard to science and learning in general, in these realms, by the Royal Society and the universities. . . . I pictured the Imperial Institute to myself as a house of call for all those who are concerned in the advancement of industry; as a place in which the home-keeping industrial could find out all he wants to know about colonial industry and the colonist about home industry; as a sort of neutral ground on which the capitalist and the artizan would be equally welcome; as a centre of intercommunication in which they might enter into friendly discussion of the problems at issue between them, and, perchance, arrive at a friendly solution of them. I imagined it a place in which the fullest stores of industrial knowledge would be made accessible to the public; in which the higher questions of commerce and industry would be systematically studied and elucidated; and where, as in an industrial university, the whole technical education of the country might find its centre and crown. If I earnestly desire to see such an institution created, it is not because I think that or anything else will put an end to pauperism and want—as somebody has absurdly suggested—but because I believe it will supply a foundation for that scientific organization of our industries which the changed conditions of the times render indispensable to their prosperity. I do not think I am far wrong in assuming that we are entering, indeed, have already entered, upon the most serious struggle for existence to which this country has ever been committed. The later years of the century promise to see us embarked in an industrial war of far more serious import than the military wars of its opening years. On the east, the most systematically-instructed and best-informed people in Europe are our competitors; on the west, an energetic offshoot of our own stock, grown bigger than its parent, enters upon

the struggle, possessed of natural resources to which we can make no pretension, and with every prospect of soon possessing that cheap labour by which they may be effectually utilized. Many circumstances tend to justify the hope that we may hold our own if we are careful to 'organize victory.' But to those who reflect seriously on the prospects of the population of Lancashire and Yorkshire—should the time ever arrive when the goods which are produced by their labour and their skill are to be had cheaper elsewhere—to those who remember the cotton famine and reflect how much worse a customer famine would be, the situation appears very grave."

An important lecture in the form of an "Address on Behalf of the National Association for the Promotion of Technical Education," was delivered at Manchester on November 29 (Coll. Essays, iii, p. 427). The purpose of the Association is stated as "the development of the industrial productivity of the country to the uttermost limits consistent with social welfare." Elementary education requires modification, for it should include some training of the faculty of observation. Drawing is strongly advocated:—

"I do not mean artistic drawing; I mean figuring natural objects: making plans and sections, approaching geometrical rather than artistic drawing. . . . The child who has been taught to make an accurate elevation, plan and section of a pint pot has had an admirable training in accuracy of eye and hand. . . . I am glad to say that in Eton, a school of whose governing body I have the honour of being a member, we, some years ago, made drawing imperative on the whole school."

The question of how best to develop technical skill is considered. The work of the Science and Art Department is spoken of and defended. Trade schools are too expensive and not accessible to wage-earners. Schools attached to factories are good, but only of partial application. Evening Classes have a wider scope, and should

be supported both by private effort and local taxation. Huxley states that he supported the principles involved in the Bill for Technical Education abandoned in 1886. This proposed to provide some authority which should sanction or veto local schemes.

The question of supply of teachers is treated in detail. A special system is required to turn out teachers of science or technology. The present system is quite inadequate for the purpose from the pupil-teacher stage upwards :—

“When does the unhappy pupil-teacher, or over-drilled student of a training college, find any time to think? I am sure that if I were in their place I could not.”

An eye must be kept on measures necessary for preserving the entire social organism in a sound and stable condition. Allusion is made to the keen and necessary competition between different nations :—

“Our sole chance of succeeding in a competition, which must continually become more and more severe, is that our people should not only have the knowledge and the skill which are required, but that they should have the will and the energy and the honesty, without which neither knowledge nor skill can be of any permanent avail.”

Any social condition involving misery, physical weakness, and degradation of the worker is bound to bring about a collapse. The question of cheapness of labour is admitted to be a difficult problem, and finally an appeal is made that in promoting industrial education an attempt shall be made to secure,—

“ . . . that the conditions of industrial life remain those in which the physical energies of the population may be maintained at a proper level; in which their moral state may be cared for; in which there may be some rays of hope and pleasure in their lives;

and in which the sole prospect of a life of labour may not be an old age of penury."

The address was a marked success, and in writing to Sir Michael Foster (on December 1) Huxley says:—

"Manchester has gone solid for technical education, and if the idiotic London papers, instead of giving half a dozen lines of my speech, had mentioned the solid contributions to the work announced at the meeting, they would have enabled you to understand its importance" (Life, ii, p. 181).

This year too we have further controversial matters with which to deal. Canon Liddon preached a sermon in which he endeavoured to explain miracles as exemplifying the suspension of lower natural laws by the intervention of higher ones. This called forth the article on "Scientific and Pseudo-Scientific Realism" (Nineteenth Century, February 1887. Coll. Essays, v, p. 59). This is the first of a series of essays afterwards collected together in the volume on *Science and Christian Tradition*. Before dealing with it, a few quotations from the Preface (dated December 4, 1893) may be given to make Huxley's general position clear.

After quoting one of Strauss's later utterances, in which he justifies the work of his life, Huxley enters a vigorous protest against the belief expressed in orthodox quarters that his own attitude was actively anti-Christian:—

"I too have reached the term at which the still, small voice, more audible than any other to the dulled ear of age, makes its demand; and I have found that it is of no sort of use to try to cook the accounts rendered. Nevertheless, I distinctly decline to admit some of the items charged; more particularly that of having 'gone out of my way' to attack the Bible; and I as steadfastly deny that 'hatred of Christianity' is a feeling with which I have any acquaintance. There are very few things which I

find it permissible to hate ; and though, it may be, that some of the organizations, which arrogate to themselves the Christian name, have richly earned a place in the category of hateful things, that ought to have nothing to do with one's estimation of the religion which they have perverted and disfigured out of all likeness to the original . . . it was the dominant ecclesiasticism of my early days, which, as I believe, without any warrant from the Bible itself, thrust the book in my way."

Then follow justifications of the controversy on the Mosaic record, and that on the miracle of the herd of swine which followed later: the agnostic attitude is defended. The Preface closes thus:—

"Those who are of the opinion that the historical realities at the root of Christianity lie beyond the jurisdiction of science, need not be considered. Those who are convinced that the evidence is, and must always remain, insufficient to support any definite conclusion, are justified in ignoring the subject. They must be content to put up with that reproach of being mere destroyers, of which Strauss speaks. They may say that there are so many problems which are and must remain insoluble that the 'burden of the mystery' 'of all this unintelligible world' is not appreciably affected by one more or less.

"For myself, I must confess that the problem of the origin of such very remarkable historical phenomena as the doctrines, and the social organization, which, in their broad features, certainly existed, and were in a state of rapid development, within a hundred years of the crucifixion of Jesus; and which have steadily prevailed against all rivals, among the most intelligent and civilized nations in the world ever since, is, and always has been, profoundly interesting; and, considering how recently the really scientific study of that problem, and how great the progress made during the last half century in supplying the conditions for a positive solution of the problem, I cannot doubt that the attainment of such a solution is a mere question of time.

"I am well aware that it has lain far beyond my powers to take any share in this great undertaking. All that I can hope is to have done somewhat towards 'the preparation of those who have ceased to be contented with the old and find no satisfaction in half measures': perhaps, also, something towards the lessening

of that great proportion of my countrymen, whose eminent characteristic it is that they find 'full satisfaction in half measures.'"

"Scientific and Pseudo-Scientific Realism" protests against the misuse of scientific terms, especially the term "law." As to the proper topic of the essay:—

"It is the use of the word 'law' as if it denoted a thing—as if a 'law of nature,' as science understands it, were a being endowed with certain powers, in virtue of which the phenomena expressed by that law are brought about. The preacher asks, 'Might not there be a suspension of a lower law by the intervention of a higher?' He tells us that every time we lift our arms we defy the law of gravitation. He asks whether some day certain 'royal and ultimate laws' may not come and 'wreck' those laws which are at present, it would appear, acting as nature's police. It is evident, from these expressions, that 'laws,' in the mind of the preacher, are entities having an objective existence in a graduated hierarchy. And it would appear that the 'royal laws' are by no means to be regarded as constitutional royalties: at any moment, they may, like Eastern despots, descend in wrath among the middle-class and plebeian laws, which have hitherto done the drudgery of the world's work, and, to use phraseology not unknown in our seats of learning—'make hay' of their belongings. Or perhaps a still more familiar analogy has suggested this singular theory; and it is thought that high laws may 'suspend' low laws, as a bishop may suspend a curate.

"Far be it from me to controvert these views, if any one likes to hold them. All I wish to remark is that such a conception of the nature of 'laws' has nothing to do with modern science. It is 'scholastic realism—realism as intense and unmitigated as that of Scotus Erigenus a thousand years ago. The essence of such realism is that it maintains the objective existence of universals, or, as we call them nowadays, general propositions."

To this essay the Duke of Argyll attempted a reply, bearing the somewhat personal heading, "Professor Huxley on Canon Liddon" (Nineteenth Century, March 1887), rebuking Huxley for attacking a church dignitary,

and raising a variety of matters in different branches of science. There were also some hyperbolic remarks about a scientific "Reign of Terror," against which a revolt was to take place.

Huxley's rejoinder "Science and Pseudo-Science" (Nineteenth Century, April 1887. Coll. Essays, v, p. 90) demolishes his opponent's arguments to some purpose, deals with the subjects advanced, reviews the chapter on "Law" in the Duke's book, *The Reign of Law* (" . . . from my point of view, a sort of 'summa' of pseudo-scientific philosophy"), and dismisses with a jest the idea of a "Reign of Terror."

The Duke, however, ventured a further attack, "A Great Lesson" (Nineteenth Century, September 1887), in which he tried to prove the existence of a scientific reign of terror by alluding to Bathybius as a mistake arising from an attempt to bolster up Darwinism, and asserting that Dr. (now Sir John) Murray's theory of coral reefs had been suppressed for some time lest it should injure Darwin's reputation by disproving some of his speculations on the same subject to be invalid.

Huxley's reply formed part of an article on "Science and the Bishops" (Nineteenth Century, November 1887), afterwards republished with the new title of "An Episcopal Trilogy" (Coll. Essays, v, p. 126). In the meantime, it should be added, another bishop had introduced the coral-reef myth into a sermon, which had been sent to Huxley by "an unknown correspondent." This fact indeed is the occasion of a very humorous passage in the "Trilogy":—

"There seems to be an impression abroad—I do not desire to give any countenance to it—that I am fond of reading sermons. From time to time, unknown correspondents—some apparently animated by the charitable desire to promote my

conversion, and others unmistakably anxious to spur me to the expression of wrathful antagonism—favour me with reports or copies of such productions.”

The Duke's assertions are shown in detail to be perfectly groundless, and a candid opinion given of his scientific accuracy:—

“In the course of his doubtless well-meant admonitions, the Duke of Argyll commits himself to a greater number of statements which are demonstrably inaccurate, and which any one who ventured to write upon the subject ought to have known to be incorrect, than I have ever seen gathered together in so small a space. . . . The most considerable difference I note among men is not in their readiness to fall into error, but in their readiness to acknowledge these inevitable lapses. The Duke of Argyll has now a splendid opportunity for proving to the world in which of these categories it is hereafter to rank him.”

This ended Huxley's part in this particular controversy, for in a subsequent article the Duke failed to take advantage of the “splendid opportunity” offered. Turning now to the first part of the “Trilogy,” we find this essay owes its name to the fact that at the British Association in Manchester (1887) the Bishops of Carlisle, Bedford and Manchester all gave sermons in which the claims of science were treated with conspicuous fairness:—

“It is impossible to read the discourses of the three prelates without being impressed by the knowledge which they display, and by the spirit of equity, I might say of generosity, towards science which pervades them. There is no trace of that tacit or open assumption that the rejection of theological dogmas, on scientific grounds, is due to moral perversity, which is the ordinary note of ecclesiastical homilies on this subject, and which makes them look so supremely silly to men whose lives have been spent in wrestling with these questions. There is no attempt to hide away real stumbling-blocks under rhetorical stucco; no resort to the *tu quoque* device of setting scientific

blunders against theological errors ; no suggestion that an honest man may keep contradictory beliefs in separate pockets of his brain ; no question that the method of scientific investigation is valid, whatever the results to which it may lead ; and that the search after truth, and truth only, ennobles the searcher and leaves no doubt that his life, at any rate, is worth living. . . . How often was it my fate, a quarter of a century ago, to see the whole artillery of the pulpit brought to bear upon the doctrine of evolution and its supporters. Any one unaccustomed to the amenities of ecclesiastical controversy would have thought we were too wicked to be permitted to live."

In dealing, however, with the Bishop of Manchester's sermon on the efficacy of prayer, Huxley points out that,—

" . . . It is not upon any *a priori* considerations that objections, either to the supposed efficacy of prayer in modifying the course of events, or to the supposed occurrence of miracles, can be scientifically based. The real objection, and, to my mind, the fatal objection, to both these suppositions, is the inadequacy of the evidence to prove any given case of such occurrences which has been adduced."

As to the fourth bishop (" Anonymous"),—

" I am afraid that if he represents any great party in the Church, the spirit of justice and reasonableness which animates the three bishops has as slender a chance of being imitated, on a large scale, as their common sense and their courtesy. For, not content with misrepresenting science on its speculative side, ' Anonymous ' attacks its morality."

Another matter of general interest for 1887 is an interview with the Premier (Lord Salisbury) in June, for the purpose of considering whether or no it would be desirable to establish an English order *Pour le Mérite*, as a recognition of distinguished services in Science, Letters and Art. His attitude was summarized by Salisbury in the words : " Well, it seems that you don't desire the

establishment of such an order, but that if you were in my place you would establish it." Long after, the idea bore fruit in the initiation of the Order of Merit (O.M).

To this year, too, must be referred the article on the "Progress of Science" (Coll. Essays, i, p. 42), written for Mr. Humphry Ward's Jubilee book on *The Reign of Queen Victoria*. This speaks of the great increase of industrial production, owing to the invention of machinery, including increased facilities of locomotion and intercommunication. The advance was largely due to Physical Science. From the times of ancient Greece science remained at a standstill for 1000 years, making renewed progress during the last three centuries. The direct influence of Bacon is challenged :—

"No delusion is greater than the notion that method and industry can make up for lack of mother wit, either in science or practical life. . . ."

A tribute is paid to Hobbes and Descartes, and the work of Galileo, Harvey, Boyle and Newton stated to be independent of Baconian and Cartesian methods. Mention is made of Pascal, Torricelli, Malpighi, Grew, Ray and Willoughby. Investigators of the highest rank are not influenced by utilitarian ends :—

"That which stirs their pulses is the love of knowledge and the joy of the discovery of the causes of things sung by the old poet—the supreme delight of extending the realm of law and order ever further towards the unattainable goals of the infinitely great and the infinitely small, between which our little race of life is run."

Technical education is reacting on science, the interests of which are identical with those of industry. "Physical science is one and indivisible." Our epoch is pre-eminent as the result of the doctrines to which it has

given birth regarding the constitution of matter, the conservation of energy, and evolution.

Mention must also be made here of a chapter "On the Reception of the *Origin of Species*," contributed to Mr. Francis Darwin's *Life and Letters of Charles Darwin* (Vol. ii, 1887, pp. 179-204). One of the concluding paragraphs of this runs as follows:—

"The known is finite, the unknown infinite; intellectually we stand on an islet in the midst of an illimitable ocean of inexplicability. Our business in every generation is to reclaim a little more land, to add something to the extent and the solidity of our possessions. And even a cursory glance at the history of the biological sciences during the last quarter of a century is sufficient to justify the assertion, that the most potent instrument for the extension of the realm of natural knowledge which has come into men's hands, since the publication of Newton's *Principia*, is Darwin's *Origin of Species*."

A certain melancholy interest attaches to 1887, because during its first half Huxley gave to the world the last three scientific memoirs he was destined to produce:—

1. "Preliminary Note on the Fossil Remains of a Chelonian Reptile, *Ceratobelys sthenurus*, from Lord Howe's Island, Australia" (Proc. Roy. Soc., xliii, 1887, pp. 232-8. Read March 31, 1887. Sci. Mem., iv, xxxv, p. 606).

2. "The Gentians: Notes and Queries" (J. Linn. Soc. (Bot.), xxiv, 1888, pp. 101-24. Read April 7, 1887. Sci. Mem., iv, xxxvi, p. 612).—The origin of this memoir has been already alluded to (*cf.* p. 181), and it is of considerable value as a study in comparative botany.

3. "Further Observations upon *Hyperodapedon Gordoni*" [an extinct reptile], (Q. J. Geol. Soc., xliii, 1887, pp. 675-94. Read May 11, 1887. Sci. Mem., iv, xxxvii, p. 636).

CHAPTER XVIII

DEFENCE OF AGNOSTICISM [1888-1889].

THE year 1888 started badly with a second attack of pleurisy, and later on heart trouble was diagnosed, proving a cause of marked weakness and depression, until it was possible to get away to Switzerland in June. Three months at Maloja, in the Upper Engadine, effected marvels, but response to the favourable conditions was much slower than on the occasion of previous Swiss visits.

At the Anniversary Meeting of the Royal Society, Huxley received the Copley Medal, and his gratification at this mark of appreciation was enhanced by the fact that Hooker had been the recipient the previous year.

His feelings are expressed in a letter to Flower (dated November 17):—

“The Royal Society has dealt very kindly with me. They patted me on the back when I started thirty-seven years ago, and it was a great encouragement. They give me their best, now that my race is run, and it is a great consolation. At the far end of life all one’s work looks so uncommonly small, that the good opinion of one’s contemporaries acquires a new value” (Life, ii, p. 212).

Several offices were necessarily abandoned in the autumn, including his position as a Governor of Eton, and also his Examinership at South Kensington, though this had involved little more than nominal responsibility for some time. His last work in the latter capacity was to draw up a new syllabus in General Biology, types

being added or discarded largely with reference to their importance as supplying the necessary facts upon which to base general principles. He was also succeeded by Hooker as Treasurer of the *Academy* Club. On the other hand he was appointed a Trustee of the British Museum.

An article on the "Industrial Struggle for Existence," made its appearance in the *Nineteenth Century* for February (Coll. Essays, ix, p. 195). The reality of the struggle for existence in its direct relation to mankind is emphasized, and undue pessimism, as well as undue optimism, deprecated. Human societies involve problems of special kind, for:—

"... society differs from nature in having a definite moral object; whence it comes about that the course shaped by the ethical man—the member of society or citizen—necessarily runs counter to that which the non-ethical man—the primitive savage, or man as a mere member of the animal kingdom—tends to adopt. The latter fights out the struggle for existence to the bitter end, like any other animal; the former devotes his best energies to the object of setting limits to the struggle."

The evolution of civilization is sketched, and the industrial problems of the present considered. To succeed in the competition with our trade rivals, our goods must not only be relatively good, but reasonably cheap. Hence labour must be paid at moderate rates, but wages cannot be reduced below a certain point. Successful competition also necessitates a state of social stability. The physical and moral welfare of the working-classes must be promoted, as well as their education in the ordinary sense. A scheme of technical education is detailed, involving the principles and including the subjects already prominently brought forward in previous addresses and essays.

The long-delayed *Obituary Notice* of Darwin for the

Royal Society was at last completed and published (Proc. Roy. Soc., xliv, 1888. Coll. Essays, ii, p. 253). In this the non-essentials of the theory of Natural Selection are clearly stated:—

“It is not essential to Darwin’s theory that anything more should be assumed than the facts of heredity, variation, and unlimited multiplication; and the validity of the deductive reasoning as to the effect of the last (that is, of the struggle for existence which it involves) upon the varieties resulting from the operation of the former. Nor is it essential that one should take up any particular position in regard to the mode of variation, whether, for example, it takes place *per saltum* or gradually; whether it is definite in character or indefinite. Still less are those who accept the theory bound to any particular views as to the causes of heredity or of variation.”

1889.

It is pleasing to know that comparative freedom from illness rendered possible that “Indian summer” of life, which made up Huxley’s few remaining years. As Mr. Leonard Huxley says:—

“From this time on, the effects of several years’ comparative rest became more perceptible. His slowly returning vigour was no longer sapped by the unceasing strain of multifarious occupations. And if his recurrent ill-health sometimes seems too strongly insisted on, it must be remembered that he had always worked at the extreme limit of his powers—the limit, as he used regretfully to say, imposed on his brain by his other organs—and that after his first breakdown he was never very far from a second. When this finally came in 1884, his forces were so far spent that he never expected to recover as he did.”

The marriage of his two remaining daughters this year facilitated a removal from London which had been in contemplation. It was decided to build a house at Eastbourne, a place which had proved beneficial to his health

in a marked degree. Building operations commenced this year, but the move did not take place till near the end of the next. The summer months were once more spent in Switzerland, first at Monte Generoso, and then at Maloja, the benefit derived being extraordinary. Walks of eighteen miles, and climbs of a thousand feet or two could be accomplished, after a time, without undue strain.

A meeting called by the Lord Mayor of London for July 1, with the object of securing support for the Pasteur Institute, was the occasion of an eloquent letter sent by Huxley to represent his opinions in the matter (Nature, July 4, 1889).

“MONTE GENEROSO, SWITZERLAND,
“June 25, 1889.

“MY LORD MAYOR,—I greatly regret my inability to be present at the meeting which is to be held, under your Lordship’s auspices, in reference to M. Pasteur and his Institute. The unremitting labours of that eminent Frenchman during the last half-century have yielded rich harvests of new truths, and are models of exact and refined research. As such they deserve, and have received, all the honours which those who are the best judges of their purely scientific merits are able to bestow. But it so happens that these subtle and patient searchings out of the ways of the infinitely little—of the swarming life where the creature that measures one-thousandth part of an inch is a giant—have also yielded results of supreme practical importance. The path of M. Pasteur’s investigations is strewn with gifts of vast monetary value to the silk trades, the brewer, and the wine merchant. And this being so, it might well be a proper and graceful act on the part of the representatives of trade and commerce in its greatest centre to make some public recognition of M. Pasteur’s services, even if there were nothing further to be said about them. But there is much more to be said. M. Pasteur’s direct and indirect contributions to our knowledge of the causes of diseased states, and of the means of preventing

their recurrence, are not measurable by money values, but by those of healthy life and diminished suffering to men. Medicine, surgery, and hygiene have all been powerfully affected by M. Pasteur's work, which has culminated in his method of treating hydrophobia. I cannot conceive that any competently instructed person can consider M. Pasteur's labours in this direction without arriving at the conclusion that, if any man has earned the praise and honour of his fellows, he has. I find it no less difficult to imagine that our wealthy country should be other than ashamed to continue to allow its citizens to profit by the treatment freely given at the Institute without contributing to its support. Opposition to the proposals which your Lordship sanctions would be equally conceivable if it arose out of nothing but the facts of the case thus presented. But the opposition which, as I see from the English papers, is threatened, has really for the most part nothing to do either with M. Pasteur's merits or with the efficacy of his method of treating hydrophobia. It proceeds partly from the fanatics of *laissez faire*, who think it better to rot and die than to be kept whole and lively by State interference, partly from the blind opponents of properly conducted physiological experimentation, who prefer that men should suffer rather than rabbits or dogs, and partly from those who for other but not less powerful motives hate everything which contributes to prove the value of strictly scientific methods of inquiry in all those questions which affect the welfare of society. I sincerely trust that the good sense of the meeting over which your Lordship will preside will preserve it from being influenced by those unworthy antagonisms, and that the just and benevolent enterprise you have undertaken may have a happy issue.—I am, my Lord Mayor, your obedient servant,
“THOMAS H. HUXLEY.”

At the Church Congress held in Manchester during the previous October, Dr. Wace, the Principal of King's College, made an attack upon Agnosticism, which was supported by Mr. Frederic Harrison and Mr. Laing, in articles contributed to the *Nineteenth Century*. This led to a series of four articles by Huxley, the first of which “Agnosticism” appeared in the same periodical for February 1889 (Coll. Essays, v, p. 209).

Dr. Wace asserted that an agnostic was merely an infidel :—

“The word infidel, perhaps, carries an unpleasant significance. Perhaps it is right that it should. It is, and it ought to be, an unpleasant thing for a man to have to say plainly that he does not believe in Jesus Christ.”

With reference to this Huxley remarks :—

“There is an attractive simplicity about this solution of the problem, and it has that advantage of being somewhat offensive to the persons attacked, which is so dear to the less refined sort of controversialist.

“Now, the question as to what Jesus really said and did is strictly a scientific problem, which is capable of solution by no other methods than those practised by the historian and the literary critic. It is a problem of immense difficulty, which has occupied some of the best heads in Europe for the last century ; and it is only of late years that their investigations have begun to converge towards one conclusion.”

The Gadarene swine are then introduced upon the scene :—

“Until the contrary is proved, I venture to doubt whether, at the present moment, any Protestant theologian, who has a reputation to lose, will say that he believes the Gadarene story.”

Further on, agnosticism is defined at length :—

“Agnosticism, in fact, is not a creed, but a method, the essence of which lies in the rigorous application of a single principle. That principle is of great antiquity ; it is as old as Socrates ; as old as the writer who said, ‘Try all things, hold fast by that which is good ;’ it is the foundation of the Reformation, which simply illustrated the axiom that every man should be able to give a reason for the faith that is in him ; it is the great principle of Descartes ; it is the fundamental axiom of modern science. Positively the principle may be expressed : in matters of the intellect, follow your reason as far as it will take you, without any regard to any other consideration. And negatively : in

matters of the intellect do not pretend that conclusions are certain which are not demonstrated or demonstrable. That I take to be the agnostic faith, which if a man keep whole and undefiled, he shall not be ashamed to look the universe in the face, whatever the future may have in store for him."

Mr. Harrison's article in the *Fortnightly Review* for January 1889, is dealt with in vigorous fashion. Should Christianity prove untenable, it will no doubt be replaced by a worthy successor :—

"But that the incongruous mixture of bad science with eviscerated papistry, out of which Comte manufactured the positivist religion, will be the heir of the Christian ages, I have too much respect for the humanity of the future to believe."

In the March number of the *Nineteenth Century* we find a subsidiary article entitled "The Value of Witness to the Miraculous" (Coll. Essays, v, p. 160). This deals with certain miracles supposed to have been wrought by the remains of two Christian martyrs, as described in *The History of the Translation of the Blessed Martyrs of Christ, SS. Marcellinus and Petrus*, written by Eginhard, an official in the Court of Charlemagne. Huxley submits that the historical evidence for these miracles is as good as if not better than that on which the miracles of the New Testament are accepted.

The same number of the *Nineteenth Century* contained replies by Dr. Wace and Bishop Magee, as well as an article by Mrs. Humphry Ward on "The New Reformation," which supported Huxley's views :—

"She has swept away the greater part of Wace's sophistries as a dexterous and strong-wristed housemaid sweeps away cobwebs with her broom, and saved a lot of time" (Letter to Knowles, Feb. 29, 1889. *Life*, ii, p. 222).

Then followed "Agnosticism: a Rejoinder," in the

Nineteenth Century for April (Coll. Essays, v, p. 263). There the difficulty of coming to any definite conclusion as to what Christ's utterances actually were is dealt with at length, and the following reasons are advanced for Huxley's advocacy of Bible-reading (*cf.* p. 102):—

“Greatly to the surprise of many of my friends, I have always advocated the reading of the Bible, and the diffusion of the study of that most remarkable collection of books among the people. Its teachings are so infinitely superior to those of the sects, who are just as busy now as the Pharisees were eighteen hundred years ago, in smothering them under ‘the precepts of men’; it is so certain, to my mind, that the Bible contains within itself the refutation of nine-tenths of the mixture of metaphysics and old-world superstition which has been piled round it by the so-called Christians of later times: it is so clear that the only immediate and ready antidote to the poison which has been mixed with Christianity, to the intoxication and delusion of mankind, lies in copious draughts from the undefiled spring, that I exercise the right and duty of free judgment on the part of every man, mainly for the purpose of inducing other laymen to follow my example. If the New Testament is translated into Zulu by Protestant missionaries, it must be assumed that a Zulu convert is competent to draw from its contents all the truths which it is necessary for him to believe. I trust that I may, without immodesty, claim to be put on the same footing as a Zulu.”

Huxley's last contribution to this controversy appeared in the *Nineteenth Century* for June, under the title of “Agnosticism and Christianity” (Coll. Essays, v, p. 309). An unexpected, mischievously humorous, turn is given to the discussion by citations from Cardinal Newman's opinions. There is no logical middle course between accepting modern as well as ancient miracles, and rejecting both:—

“Dr. Newman made his choice and passed over to the Roman Church half a century ago. Some of those who were essentially in harmony with his views preceded, and many followed him.

But many remained: and, as the quondam Puseyite and present Ritualistic party, they are continuing that work of sapping and mining the Protestantism of the Anglican Church which he and his friends so ably commenced. At the present time, they have no little claim to be considered victorious all along the line. I am old enough to recollect the small beginnings of the Tractarian party, and I am amazed when I consider the present position of their heirs. Their little leaven has leavened, if not the whole, yet a very large lump of the Anglican Church; which is now pretty much of a preparatory school for Papistry. So that it really behoves Englishmen (who, as I have been informed by high authority, are all legally members of the State Church, if they profess to belong to no other sect) to wake up to what that powerful organization is about, and whither it is tending. On this point, the writings of Dr. Newman, while he still remained within the Anglican fold, are a vast store of the best and the most authoritative information. His doctrines on Ecclesiastical miracles and on development are the corner-stones of the Tractarian fabric. He believed that his arguments led either Romeward, or to what ecclesiastics call 'Infidelity,' and I call Agnosticism. I believe that he was quite right in this conviction, but while he chooses the one alternative, I choose the other. . . ."

It has been mentioned that Bishop Magee took part in the controversy on Agnosticism, and it is desirable in this place to quote a foot-note added by Huxley to the essay on "Agnosticism," in Vol. V. of the *Collected Essays* (p. 210):—

"In this place and in the eleventh essay ('Illustrations of Mr. Gladstone's Controversial Methods'), there are references to the late Archbishop of York, which are of no importance to my main argument, and which I have expunged, because I desire to obliterate the traces of a temporary misunderstanding with a man of rare ability, candour, and wit, for whom I entertained a great liking and no less respect. I rejoice to think now of the (then) Bishop's cordial hail the first time we met after our little skirmish, 'Well, is it to be peace or war?' I replied, 'A little of both.' But there was only peace when we parted, and ever after."

Huxley's "Autobiography" was also written this year

(Coll. Essays, i, p. 1), and published as part of a series of biographical sketches by C. Engel. Several quotations from it have already been made (pp. 1, 2, 4, 21, 34). He also took part in a correspondence which appeared in the *Times*, in the later part of the year, and arose out of questions as to private property in land, propounded to Mr. John Morley at Newcastle. This led to a series of articles on political philosophy, contributed to the *Nineteenth Century* for 1890, the first being written before the close of 1889.

CHAPTER XIX

POLITICAL PHILOSOPHY—MORE CRITICAL THEOLOGY
[1890-1891].

THE events of 1890 include a trip to the Canaries of Huxley and his son Harry, whom he wished to give "a run for a month or six weeks," on the completion of his course as a medical student. The travellers left London on April 3, and reached the Islands on April 10, leaving again for Madeira on May 2. What with the voyage and the open-air life, Huxley by this time felt "ten years younger." The botanical interests aroused by study of the gentians are evidenced in a letter written to Hooker immediately after the return home. During his absence the Linnean Society had awarded him the Linnean Medal, to which the letter in question (dated May 18) alludes, with special reference to the digestive dangers of a public dinner:—

"But what is a man to do if his friends take advantage of his absence, and go giving him gold medals behind his back? That you have been an accomplice in this nefarious plot—mine own familiar friend whom I trusted and trust—is not to be denied. Well, it is very pleasant to have toil that is now all ancient history remembered, and I shall go to the meeting and the dinner and make my speech in spite of as many possible devils of dyspepsia as there are plates and dishes on the table" (*Life*, ii, pp. 256-7).

The move into the new house at Eastbourne took place early in December, the name "Hodeslea" being selected, "which is as near as I can go to 'Hodesleia,'

the poetical original shape of my very ugly name." A large part of his library was presented to the Royal College of Science, and the Registrar, in returning thanks for the gift, communicated the resolution which had been adopted :—

"That the library shall be kept in the room formerly occupied by the Dean, which shall be called 'The Huxley Laboratory for Biological Research,' and be devoted to the prosecution of original Researches in Biological Science, with which the name of Professor Huxley is inseparably associated" (Life, ii, p. 284).

The first of the series of essays upon political philosophy, "The Natural Inequality of Men," appeared in the *Nineteenth Century* for January (Coll. Essays, i, p. 290). It deals with the inexact ideas regarding natural equality, rights in property, and so on, which first attained prominence in the writings of Rousseau, and had recently been promulgated afresh. The second of the series, "Natural and Political Rights," in the February number (Coll. Essays, i, p. 336), analyzes the views of Henry George, as given in *Progress and Poverty*, which is essentially a presentment of Rousseauism recast.

The third essay, "Capital, the Mother of Labour," in the March number (Coll. Essays, ix, p. 147), deals with "An Economical Problem discussed from a Physiological Point of View," arriving at the following conclusions :—

"I think it may not be too much to say that, of all the political delusions which are current in this queer world, the very stupidest are those which assume that labour and capital are necessarily antagonistic; that all capital is produced by labour and therefore, by natural right, is the property of the labourer; that the possessor of capital is a robber who preys on the workman and appropriates to himself that which he has had no share in producing.

"On the contrary, capital and labour are, necessarily, close allies; capital is never a product of human labour alone; it

exists apart from human labour ; it is the necessary antecedent of labour ; and it furnishes the materials on which labour is employed. The only indispensable form of capital—vital capital—cannot be produced by human labour. All that man can do is to favour its formation by the real producers. There is no intrinsic relation between the amount of labour bestowed on an article and its value in exchange. The claim of labour to the total result of operations which are rendered possible only by capital is simply an *à priori* iniquity.”

The fourth and last essay in the series, “ Government : Anarchy or Regimentation,” appeared in May (Coll. Essays, i, p. 383), and here the results of putting into practice extreme individualism on the one hand, or extreme socialism on the other, are vividly sketched, and the foundations of the two critically examined. The previous essays had evoked numerous criticisms of the most diverse kind, and the socialists conceived them to be written with the intention of supporting the existing state of things, and opposing progress. In the essay on “ Government,” this last charge is thus answered :—

“ Those who have had the patience to follow me to the end will, I trust, have become aware that my aim has been altogether different. Even the best of modern civilizations appears to me to exhibit a condition of mankind which neither embodies any worthy ideal nor even possesses the merit of stability. I do not hesitate to express my opinion that, if there is no hope of a large improvement of the condition of the greater part of the human family ; if it is true that the increase of knowledge, the winning of a greater dominion over Nature which is its consequence, and the wealth which follows upon that dominion, are to make no difference in the extent and the intensity of Want, with its concomitant physical and moral degradation, among the masses of the people, I should hail the advent of some kindly comet, which would sweep the whole affair away, as a desirable consummation. What profits it to the human Prometheus that he has stolen the fire of heaven to be his servant, and that the spirits of the earth and of the air obey him, if the vulture of

pauperism is eternally to tear his very vitals and keep him on the brink of destruction.

“Assuredly, if I believed that any of the schemes hitherto proposed for bringing about social amelioration were likely to attain their end, I should think what remains to me of life well spent in furthering it. But my interest in these questions did not begin the day before yesterday; and, whether right or wrong, it is no hasty conclusion of mine that we have small chance of doing rightly in this matter (or indeed in any other) unless we think rightly. Further, that we shall never think rightly in politics until we have cleared our minds of delusions, and more especially of the philosophical delusions which, as I have endeavoured to show, have infested political thought for centuries. My main purpose has been to contribute my mite towards this essential preliminary operation. Ground must be cleared and levelled before a building can be properly commenced; the labour of the navy is as necessary as that of the architect, however much less honoured; and it has been my humble endeavour to grub up those old stumps of the *à priori* which stand in the way of the very foundations of a sane political philosophy. To those who think that questions of the kind have merely an academic interest, let me suggest once more that a century ago Robespierre and St. Just proved that the way of answering them may have extremely practical consequences.”

A sermon published by Canon Liddon upholding the authority of such portions of the Old Testament as are quoted by Christ in the New, led to the writing of an article, “The Lights of the Church and the Light of Science,” for the July number of the *Nineteenth Century* (Coll. Essays, iv, p. 201). The essay agrees with the conclusion that there is a vital relation between the New and Old Testaments:—

“I am fairly at a loss to comprehend how any one, for a moment, can doubt that Christian theology must stand or fall with the historical trustworthiness of the Jewish Scriptures.”

There is no reason why one particular group of historical writings should be exempt from the methods

of criticism applied to such works in general. The progress of higher criticism is sketched, and the case of the Deluge dealt with in detail. Finally, the untenability of the clerical position is commented on in strong terms :—

“ It is, indeed, probable that the proportional number of those who will distinctly profess their belief in the transubstantiation of Lot’s wife, and the anticipatory experience of submarine navigation by Jonah : in water standing fathoms deep on the side of a declivity without anything to hold it up ; and in devils who enter swine—will not increase, but neither is there ground for much hope that the proportion of those who cast aside these fictions and adopt the consequence of that repudiation, are, for some generations, likely to constitute a majority. Our age is a day of compromises. The present and the near future seem given over to those happily, if curiously, constituted people who see as little difficulty in throwing aside any amount of post-Abrahamic Scriptural narrative, as the authors of *Lux Mundi* see in sacrificing the pre-Abrahamic stories ; and, having distilled away every inconvenient matter of fact in Christian history, continue to pay divine honours to the residue.”

We have also for 1890 a renewal of controversy with Mr. Gladstone, who, in the autumn, wrote an article for *Good Words* on “ The Impregnable Rock of Holy Scripture,” in which the position taken up by Huxley the previous year was attacked. The Preface (dated December 4, 1893) to Vol. V. of the *Collected Essays*, as already indicated (*cf.* p. 193), sets forth the circumstances which led to work in critical theology, first as regards the Old Testament, then as regards the New :—

“ I had set out on a journey, with no other purpose than that of exploring a certain province of natural knowledge ; I strayed no hair’s-breadth from the course which it was my right and my duty to pursue ; and yet I found that, whatever route I took, be-

fore long, I came to a tall and formidable-looking fence. Confident as I might be in the existence of an ancient and indefeasible right-of-way, before me stood the thorny barrier with its comminatory notice-board—‘No Thoroughfare. By Order. Moses.’ There seemed no way over; nor did the prospect of creeping round, as I saw some do, attract me. . . . The only alternatives were either to give up my journey—which I was not minded to do—or to break the fence down and go through it.”

As to the extension of criticism to the New Testament:—

“Thirty years ago, criticism of ‘Moses’ was held by most respectable people to be deadly sin; now it has sunk to the rank of a mere peccadillo; at least, if it stops short of the history of Abraham. . . .

“Well, we will pass the item of 1860, said the ‘voice’ [of conscience]. But why all this more recent coil about the Gadarene swine and the like? Do you pretend that these poor animals got in your way, years and years after the ‘Mosaic’ fences were down, at any rate so far as you are concerned? Got in my way? why my good ‘voice,’ they were driven in my way. . . .

“The half-hearted religiosity of latter-day Christianity may choose to ignore the fact; but it remains none the less true, that he who refuses to accept the demonology of the Gospels rejects the revelation of a spiritual world, made in them, as much as if he denied the existence of such a person as Jesus of Nazareth; and deserves, as much as any one can do, to be ear-marked ‘infidel’ by our gentle shepherds.”

The reply to Mr. Gladstone’s attack appeared in the December number of the *Nineteenth Century*, under the title of “The Keepers of the Herd of Swine” (Coll. Essays, v, p. 336). One reason for undertaking the article is to clearly state the position of the writer, for,—

“the warmest admirers of Mr. Gladstone will hardly be prepared to maintain that mathematical accuracy in stating the

opinions of an opponent is the most prominent feature of his controversial method."

A much more bitter controversy in regard to the Salvation Army, in which Huxley took part, began in the *Times* towards the end of the year, but an account of this may for the moment be postponed.

The November number of the *Nineteenth Century* contained his last contribution to pure science, entitled "On the Aryan Question" (Coll. Essays, vii, p. 271). To eliminate any suspicion of personal predilection, he humorously remarks:—

"The combination of swarthinness with stature above the average and a long skull, confer upon me the serene impartiality of a mongrel."

He is inclined to admit that the "primitive Aryans" were a distinct race, and favours, for working purposes, a modification of Latham's Sarmatian hypothesis as against the older Hindoo-Koosh-Pamir theory. The probable cradle of the Aryan race is defined as including "the higher parts and a good deal of the northern slopes of Europe between the Ural and the German Ocean. . . ."

Then follows an account of the physical characters of the earliest known prehistoric inhabitants of Europe known to science by their actual remains, as against still more ancient races of which only the weapons, implements, etc., now remain:—

"As some writing of mine on the subject [*i.e.* Neanderthal Man, etc., *cf.* pp. 65, 74] led to my occupation of a prominent position among the belaboured dogs of that day, I have taken a mild interest in watching the gradual rehabilitation of my old friend of the Neanderthal among normal men, which has been going on of late years."

And finally the opinion is expressed that the Neander-

thal race is so immensely ancient that, were our knowledge complete, it would be possible to connect the type with existing Aryans by a series of imperceptible gradations.

Had not Huxley's health compelled the abandonment of scientific research, large and important additions would have been made to the enormous mass actually published. An account of his unfinished work is given in Appendix I. to his *Life and Letters*, as drawn up by the late Prof. G. B. Howes after examination of the drawings and manuscript papers which form part of the Library presented to the Royal College of Science.

1891.

A legacy, in the form of a small estate at Worthing, from Mr. Anthony Rich, the antiquarian, afforded the means of buying a piece of ground adjacent to Hodeslea, thus contributing greatly to the happiness of Huxley's remaining years, by enabling him to gratify a newly-discovered taste for gardening. In a letter to Hooker (dated July 3, 1891), for example, we read: "I find nailing up creepers a delightful occupation" (*Life*, ii, p. 287).

And in a letter to the late Prof. T. J. Parker (dated August 11, 1891), he says:—

" . . . I begin to think with *Candide* that 'cultivons notre jardin' comprises the whole duty of man" (*Life*, ii, p. 289).

Most of the year was spent in Eastbourne, but in September he and his wife visited the Wye valley and Llangollen, returning by way of Chester, for the purpose of seeing Old Huxley Hall, the original home of the family. An opportunity was also taken of renewing the memories of youth, by including Coventry in the itinerary

and going to look at the house there in which he had once lived.

Of controversy for the year there is no lack. Articles in answer to "The Keepers of the Herd of Swine" appeared in the *Nineteenth Century* for January and February, by the Duke of Argyll and Mr. Gladstone respectively. The next number contained Huxley's rejoinder, entitled "Mr. Gladstone's Controversial Methods" (Coll. Essays, v, p. 393). The Gadarene swine question is here entered into very fully, and discussed as a historical problem in the solution of which all available facts are employed. And as the title indicates, the article deals not only with the matter but also the manner of Gladstone's attacks,—

"couched in language which certainly does not err upon the side of moderation or of courtesy. . . .

"Persons who, like myself, have spent their lives outside the political world, yet take a mild and philosophic concern in what goes on in it, often find it difficult to understand what our neighbours call the psychological moment of this or that party leader, and are, occasionally, loth to believe in the seeming conditions of certain kinds of success. And when some chieftain, famous in political warfare, adventures into the region of letters or of science, in full confidence that the methods which have brought fame and honour in his own province will answer there, he is apt to forget that he will be judged by those people on whom rhetorical artifices have long ceased to take effect, and to whom mere dexterity in putting together cleverly ambiguous phrases, and even the great art of offensive misrepresentation, are unspeakably wearisome. And, if that weariness finds its expression in sarcasm, the offender really has no right to cry out. Assuredly, ridicule is no test of truth, but it is the righteous meed of some kinds of error."

Since the Duke of Argyll did not take the opportunity of withdrawing certain erroneous statements (*cf.* p. 197), further controversy with him is declined.

Two other contributions to critical theology, "Hasi-dadra's Adventure," and "Possibilities and Impossibilities," naturally connect here. The former (Nineteenth Century, June 1891. Coll. Essays, iv, p. 239) analyzes the evidence for a universal deluge. The Babylonian version of the flood myth is taken as the basis for discussion, and after a full consideration of the geological, geographical, and other data, the following conclusion is reached :—

"Thus it would seem that the Euphrates valley, the centre of the fabled Noachian deluge, is also the centre of a region covering some millions of square miles of the present continents of Europe, Asia, and Africa, in which all the facts, relevant to the argument, at present known, converge to the conclusion that, since the miocene epoch, the essential features of its physical geography have remained unchanged; that it has neither been depressed below the sea, nor swept by diluvial waters since that time; and that the Chaldean version of the legend of a flood in the Euphrates valley is, of all those which are extant, the only one which is even consistent with probability, since it depicts a local inundation, not more severe than one which might be brought about by a concurrence of favourable conditions at the present day; and which might probably have been more easily effected when the Persian Gulf extended farther north."

A "Postscript" to this article contains an interesting paragraph :—

"My best thanks are due to Mr. Gladstone for his courteous withdrawal of one of the statements to which I have thought it needful to take exception. The familiarity with controversy, to which Mr. Gladstone alludes, will have accustomed him to the misadventures which arise when, as sometimes will happen in the heat of fence, the buttons come off the foils. I trust that any scratch which he may have received will heal as quickly as my own flesh wounds have done."

The second article, on "Possibilities and Impossi-

bilities" (Agnostic Annual, 1892, published October 1891. Coll. Essays, v, p. 192), deals with the agnostic attitude in regard to miracles, of which the one relating to the Gadarene Swine had been the subject of so much controversy :—

"Let us be content with rational certainty, leaving irrational certainties to those who like to muddle their heads with them. I cannot see my way to say that demons are impossibilities; but I am not more certain about anything than I am that the evidence tendered in favour of the demonology, of which the Gadarene story is a typical example, is utterly valueless. I cannot see my way to say that it is 'impossible' that the hunger of thousands of men should be satisfied out of the food supplied by half-a-dozen loaves and a fish or two; but it seems to me monstrous that I should be asked to believe it on the faith of the five stories which testify to such an occurrence."

The controversy on the Salvation Army "Darkest England Scheme," which commenced near the end of 1890, had a rather curious origin. A lady who was willing to subscribe £1000 to this scheme first asked Huxley for his advice in the matter, and the results of his investigations are embodied in "Social Diseases and Worse Remedies, Letters to the *Times* on Mr. Booth's Scheme. With a Preface and Introductory Essay" (Coll. Essays, ix, p. 188). The conclusions reached were that serious political and social dangers might be involved in such a scheme; that it might seriously interfere with other philanthropic enterprises; and that the administration in a reasonable matter of funds subscribed was not properly secured. But after detailing in the Preface the possible evils which might result from the scheme, Huxley expressly says :—

"I entirely acquit Mr. Booth of any complicity in far-reaching schemes of this kind; but I did not write idly when, in my first

letter, I gave no vague warning of what might grow out of the organized force, drilled in the habit of unhesitating obedience, which he has created."

Allusion has already been made (*cf.* p. 202) to the Introductory Essay on "The Struggle for Existence in Human Society," prefixed to the reprinted letters.

Some of Huxley's Essays on Education were translated into French during 1891, and published under the title of *Les Sciences Naturelles et l'Education*, he himself contributing a preface. The French edition of "Man's Place in Nature" (*La Place de l'Homme dans la Nature*), which had appeared more than a score of years previously, was also re-issued, together with translations by H. de Varigny of three ethnological essays. A letter to the translator (dated May 17, 1891) contains the following paragraph:—

"I am quite conscious that the condensed and idiomatic English into which I always try to put my thoughts, must present many difficulties to a translator. But a friend of mine who is a much better French scholar than I am, and who looked over two or three of the essays, told me he thought you had been remarkably successful (*Life*, ii, pp. 290-1).

Another quotation from the same letter has been given elsewhere (*cf.* p. 23).

Mention has already been made, in several places, of Huxley's devotion to the mother tongue he handled in so masterly a fashion, and on the teaching of which he held very strong views. These find expression in a letter to the *Pall Mall Gazette* (October 22, 1891), the occasion being the establishment of a Chair in the University of Oxford, nominally of English Literature, really of Middle English Philology. Here he states his conviction:—

“Firstly, that the works of our great English writers are pre-eminently worthy of being systematically studied in our schools and universities as literature; and secondly, that the establishment of professional chairs of philology, under the name of literature, may be a profit to science, but is really a fraud practised upon letters.

“That a young Englishmen may be turned out of one of our universities, ‘epopt and perfect’ so far as their system takes him, and yet ignorant of the noble literature which has grown up in these islands during the last three centuries, no less than of the development of the philosophical and political ideas which have most profoundly influenced modern civilization, is a fact in the history of the nineteenth century which the twentieth will find hard to believe; though, perhaps, it is not more incredible than our current superstition that whose wishes to write and speak English well should mould his style after the models furnished by classical antiquity. . . . But still I mark among distinguished contemporary speakers and writers of English, saturated with antiquity, not a few to whom, it seems to me, the study of Hobbes might have taught dignity; of Swift, concision and clearness; of Goldsmith and Defoe, simplicity.

“Well, among a hundred young men whose university career is finished, is there one whose attention has ever been directed by his literary instructors to a page of Hobbes, or Swift, or Goldsmith, or Defoe? In my boyhood we were familiar with *Robinson Crusoe*, *The Vicar of Wakefield*, and *Gulliver’s Travels*; and though the mysteries of ‘Middle English’ were hidden from us, my impression is, we ran less chance of learning to write and speak the ‘middling English’ of popular orators and headmasters than if we had been perfect in such mysteries and ignorant of those three masterpieces. It has been the fashion to decry the eighteenth century, as young fops laugh at their fathers. But we were there in germ; and a ‘Professor of Eighteenth-Century History and Literature’ who knew his business might tell young Englishmen more of that which it is profoundly important they should know, but which at present remains hidden from them, than any other instructor; and, incidentally, they would learn to know good English when they see or hear it—perhaps even to discriminate between slipshod copiousness and true eloquence, and that alone would be a great gain.”

A number of our teaching institutions have been concerned of late years with the difficult task of training agricultural students; and the framing of courses embodying science and practice in suitable proportions has engaged the attention and led to the co-operation of professional scientists and "practical" men, not always with the happiest result. Huxley's views on the subject are indicated in a letter to the *Yorkshire Herald* (April 11, 1891), answering questions asked by Mr. J. Harrison, who had been preparing a paper on "Technical Education as applied to Agriculture" for the Easingwold Agricultural Club:—

"I am afraid that my opinion upon the subject of your inquiry is worth very little—my ignorance of practical agriculture being profound. However, there are some general principles which apply to all technical training; the first of these, I think, is that practice is to be learned only by practice. The farmer must be made by and through farm work. I believe I might be able to give you a fair account of a bean plant and of the manner and condition of its growth, but if I were to try to raise a crop of beans, your club would probably laugh consumedly at the result. Nevertheless, I believe that you practical people would be all the better for the scientific knowledge which does not enable me to grow beans. It would keep you from attempting hopeless experiments, and would enable you to take advantage of the innumerable hints which Dame Nature gives to people who live in direct contact with things. And this leads me to the second general principle, which I think applies to all technical teaching for school-boys and school-girls, and that is, that they should be led from the observation of the commonest facts to general scientific truths. If I were called upon to frame a course of elementary instruction preparatory to agriculture, I am not sure I should attempt chemistry, or botany, or physiology, or geology, as such. It is a method fraught with the danger of spending too much time and attention on abstraction and theories, on words and notions instead of things. The history of a bean, of a grain of wheat, of a turnip, of a sheep, of a pig, or of a cow, properly treated—with the introduction of the elements of

chemistry, physiology, and so on as they come in—would give all the elementary science which is needed for the comprehension of the processes of agriculture in a form easily assimilated by the youthful mind, which loathes everything in the shape of long words and abstract notions, and small blame to it.”

CHAPTER XX

CLOSING YEARS [1892-1895].

It is generally understood that Huxley might have had a title in recognition of his eminence as a scientist, but his views on the subject were very clearly defined and were expressed, for instance, in his address on "Administrative Nihilism" (Coll. Essays, i, p. 287):—

"The sole order of nobility which, in my judgment, becomes a philosopher, is the rank which he holds in the estimation of his fellow-workers, who are the only competent judges in such matters. Newton and Cuvier lowered themselves when the one accepted an idle knighthood, and the other became a baron of the empire. The great men who went to their graves as Michael Faraday and George Grote seem to me to have understood the dignity of knowledge better when they declined all such meretricious trappings."

His objection, however, did not apply to men of science occupying official posts, and given titles on that account. Nor did it extend to membership of the Privy Council (an office involving a title), as once stated in conversation to Sir John Donnelly. And, during the summer of 1892, Huxley was offered and accepted the distinction of a Privy Councillorship, Donnelly, as Secretary of the Science and Art Department, having first been sounded on the matter. The compliment gave very natural pleasure, not unmingled with a little quiet amusement. Both these elements, for example, together with appreciation of long-standing friendship, are to be found in a letter to Donnelly (dated August 20, 1892):—

“I began to think that Lord Salisbury had thought better of it—(I should not have been surprised at all if he had), and was going to leave me a P.P.C. instead of a P.C. when the announcement appeared yesterday.

“This morning, however, I received his own letter (dated the 16th), which has been following me about. A very nice letter it is too—he does the thing handsomely while he is about it.

“Well, I think the thing is good for science; I am not such a self humbug as to pretend that my vanity is not pleasantly tickled; but I do not think there is any aspect of the affair more pleasant to me, than the evidence it affords of the strength of our old friendship. Because, with all respect for my noble friends, deuce a one would ever have thought of it, unless you had not only put it—but rubbed it—into their heads” (Life, ii, pp. 323-4).

And again, to Hooker (same date):—

“You will have seen that I have been made a P.C. If I had been offered to be made a police constable I could not have been more flabbergasted than I was when the proposition came to me a few weeks ago. . . . The Archbishopric of Canterbury is the only object of ambition that remains to me” (Life, ii, p. 324).

The already thinned ranks of the *x* Club were still further diminished by the deaths of T. A. Hirst in February, and Tennyson in October. Huxley attended the funeral of the latter in Westminster Abbey, and afterwards wrote some verses by way of farewell, published in the *Nineteenth Century* for November. We find from Mr. Wilfrid Ward’s reminiscences that:—

“Tennyson he considered the greatest English master of melody except Spenser and Keats” (Life, ii, p. 338).

And in a letter to Tyndall (dated October 15, 1892), Tennyson is described as:—

“. . . the first poet since Lucretius who has understood the drift of science” (loc. cit.).

Late in 1891 thirty-eight of the clergy of the Church of England issued a manifesto declaring the Bible to be inspired and infallible, upon which a very lively controversy in the *Times* ensued. Huxley was dragged into this, and contributed four letters during the early part of 1892. Of these the second (dated February 3), is perhaps the most important, as bringing into sharp contrast the teachings of Genesis and those of natural science :—

“ I conceive the first chapter of Genesis to teach—(1) that the species of animals and plants owe their origin to supernatural acts of creation ; (2) that these acts took place at such times and in such a manner that all the plants were created first, all the aquatic and aerial animals (notably birds) next, and all terrestrial animals last. I am not aware that any Hebrew scholar denies that these propositions agree with the natural sense of the text. Sixty years ago I was taught, as most people were then taught, that they are guaranteed by Divine authority.

“ On the other hand, in my judgment, natural science teaches no less distinctly—(1) that the species of animals and plants have originated by a process of natural evolution ; (2) that this process has taken place in such a manner that the species of animals and plants, respectively, have come into existence one after another throughout the whole period since they began to exist on the earth ; that the species of plants and animals known to us are, as a whole, neither older nor younger the one than the other. . . .

“ Until it is shown that the first two propositions are not contained in the first chapter of Genesis, and that the second pair are not justified by the present condition of our knowledge, I must continue to maintain that natural science and the ‘ Mosaic ’ account of the origin of animals and plants are in irreconcilable antagonism.”

The controversial essays of more recent years were now republished in volume form as *Controverted Questions*, the long “ Prologue ” to which, “. . . cost me more time and pains than any equal number of pages I have ever

written" (Life, ii, p. 298). It is reprinted in the *Collected Essays* (v, p. 1).

The Prologue is designed to show that the essays it precedes, though apparently disconnected, are :—

“ . . . concerned only with different aspects of a single problem, with which thinking men have been occupied, ever since they began seriously to consider the wonderful frame of things in which their lives are set, and to seek for trustworthy guidance among its intricacies. . . .

“ Men are growing to be seriously alive to the fact that the historical evolution of humanity, which is generally, and I venture to think not unreasonably, regarded as progress, has been, and is being, accompanied by a co-ordinate elimination of the supernatural from its originally large occupation of men's thoughts. The question—How far is this process to go?—is, in my apprehension, the Controverted Question of our time.”

The stages in the gradual escape of thinking humanity from the trammels of authority and dogma are then briefly traced, and the scientific Naturalism which marks the close of the last century is shown to be constructive as well as destructive :—

“ But the present incarnation of the spirit of the Renaissance differs from its predecessor in the eighteenth century, in that it builds up, as well as pulls down. . . .

“ That of which it has laid the foundation, of which it is already raising the superstructure, is the doctrine of evolution.”

Next follows a condensed statement of the great evolutionary truths, to which “all future philosophical and theological speculations will have to accommodate themselves,” and the Prologue ends with an appreciation of the Bible, regarded as a collection of historical and literary documents :—

“ It appears to me that if there is anybody more objectionable than the orthodox Bibliolater, it is the heterodox Philistine, who

can discover in a literature which, in some respects, has no superior, nothing but a subject for scoffing and an occasion for the display of his conceited ignorance of the debt he owes to former generations."

The plea advanced many years before (*cf.* p. 102) for the use of the Bible in schools is repeated, and stress is laid, ". . . upon the necessity of placing such instruction in lay hands." Finally the part played by the Bible in history is eloquently set forth :—

"I may add yet another claim of the Bible to the respect and the attention of a democratic age. Throughout the history of the western world, the Scriptures, Jewish and Christian, have been the great instigators against the worst forms of clerical and political despotism. The Bible has been the *Magna Charta* of the poor and of the oppressed; down to modern times, no State has had a constitution in which the interests of the people are so largely taken into account, in which the duties, so much more than the privileges, of rulers, are insisted upon, as that drawn up for Israel in Deuteronomy and in Leviticus; nowhere is the fundamental truth that the welfare of the State, in the long run, depends on the uprightness of the citizen, so strongly laid down. Assuredly, the Bible talks no trash about the rights of man; but it insists on the equality of duties, on the liberty to bring about that righteousness which is somewhat different from struggling for 'rights'; on the fraternity of taking thought for one's neighbour as for one's self.

"So far as such equality, liberty, and fraternity, are included under the democratic principles which assume the same names, the Bible is the most democratic book in the world. As such it began, through the heretical sects, to undermine the clerico-political despotism of the Middle Ages, almost as soon as it was formed, in the eleventh century; pope and king had as much as they could do to put down the Albigenses and the Waldenses in the twelfth and thirteenth centuries; the Lollards and the Hussites gave them still more trouble in the fourteenth and fifteenth; from the sixteenth century onward, the Protestant sects have favoured political freedom in proportion to the degree in which they have refused to acknowledge any ultimate authority save that of the Bible.

“ But the enormous influence which has thus been exerted by the Jewish and Christian Scriptures has had no necessary connection with cosmogonies, demonologies, and miraculous interferences. Their strength lies in their appeals, not to the reason, but to the ethical sense. I do not say that even the highest biblical ideal is exclusive of others or needs no supplement. But I do believe that the human race is not yet, possibly may never be, in a position to dispense with it.”

The inclusion of the essay on “Agnosticism” in *Controverted Questions* led Mr. Frederic Harrison, in a friendly article contributed to the *Fortnightly Review*, to object to the identification of his views with those of Comte. Huxley’s reply, “An Apologetic Irenicon,” appeared in the November number of the same periodical, and in this he objects to agnosticism being considered a mere preliminary to positivism. He disclaims any intention of setting up as an instructor of the human race, and meets the reproach that his utterances had been negative in kind by pointing out the necessity for destructive criticism, the work of clearing the ground, at the same time adding:—

“ I venture to count it an improbable suggestion that any such person—a man, let us say, who has well-nigh reached his three-score years and ten, and has graduated in all the faculties of human relationships; who has taken his share in all the deep joys and deeper anxieties which cling about them; who has felt the burden of young lives entrusted to his care, and has stood alone with his dead before the abyss of the eternal—has never had a thought beyond negative criticism. It seems to me incredible that such an one can have done his day’s work, always with a light heart, with no sense of responsibility, no terror of that which may appear when the factitious veil of Isis—the thick web of fiction man has woven round nature—is stripped off.”

A good deal of the article is in some sort anticipatory of the matter included in the Romanes Lecture on “Evolution and Ethics,” delivered the following year.

During 1892, too, the first volume of Huxley's *Collected Essays* appeared in the "Eversley Series," under the name of *Method and Results*, and this included, like all its successors, a special Preface.

The necessity for establishing a teaching University for London was now becoming a pressing question, and there can be no doubt that the University of London, as now modified, owes very much to his energy and sound judgment. For one thing, as Professor Karl Pearson says :—

" . . . Professor Huxley's leadership did, at any rate, a great deal to unite the London teachers, and raise their ideal of a true university, while at the same time helping to repress the self-interests of many persons and institutions which had been before very much to the front " (Life, ii, p. 314).

Huxley's ideal is expressed in a letter to Professor Ray Lankester (dated April 11, 1892) :—

" The mediæval university looked backwards ; it professed to be a storehouse of old knowledge, and except in the way of dialectic cobweb-spinning, its professors had nothing to do with novelties. Of the historical and physical (natural) sciences, of criticism and laboratory practice, it knew nothing. Oral teaching was of supreme importance on account of the cost and rarity of manuscripts.

" The modern university looks forward : its professors have to be at the top of the wave of progress. Research and criticism must be the breath of their nostrils ; laboratory work the main business of the scientific student ; books his main helpers.

" The lecture, however, in the hands of an able man will still have the utmost importance in stimulating and giving facts and principles their proper relative prominence " (Life, ii, p. 309).

The advantages of Oxford and Cambridge, and one advance made by them in the "modern" direction, are indicated in a letter to Mr. Briton Riviere :—

" . . . in the way of practical advantage in any career, there

is a great deal to be said for sending a clever boy to Oxford or Cambridge. There are not only the exhibitions and scholarships, but there is the rubbing shoulders with the coming generation, which puts a man in touch with his contemporaries as hardly anything else can do. A very good scientific education is to be had at both Cambridge and Oxford, especially Cambridge now" (Life, ii, 318).

The relation of the State to both elementary and intermediate education is discussed in a letter to Sir John Donnelly (dated October 1, 1892):—

"As to intermediate education, I have never favoured the notion of State intervention in this direction.

"I think there are only two valid grounds for State meddling with education: the one the danger to the community which arises from dense ignorance; the other the advantage to the community of giving capable men the chance of utilizing their capacity.

"The first furnishes the justification for compulsory elementary education. If a child is taught reading, writing, drawing, and handiwork of some kind; the elements of mathematics, physics, and history, and I should add of political economy and geography, books will furnish him with everything he can possibly need to make him a competent citizen in any rank of life.

"If with such a start, he has not the capacity to get all he needs out of books, let him stop where he is. Blow him up with intermediate education as much as you like, you will only do the fellow a mischief and lift him into a place for which he has no real qualification. People never will recollect, that mere learning and mere cleverness are of next to no value in life, while energy and intellectual grip, the things that are inborn and cannot be taught, are everything. . . .

"I quite agree with you, therefore, that it will play the deuce if intermediate education is fossilized as it would be by any Act prepared under present influences. The most I should like to see done, would be to help the youth of special literary, linguistic and so forth, capacity, to get the best training in their special line" (Life, ii, pp. 319-20).

1893.

The Romanes Lecture on "Evolution and Ethics," delivered by Huxley at Oxford on May 18, was the chief event for 1893. Unfortunately, as a sequel to influenza, his voice was far from strong, and a good deal was inaudible to many of the large audience assembled in the Sheldonian theatre. As all reference to politics or religion was forbidden, the difficulties of dealing with such a subject was greatly increased.

In this address the "evolution of ethics" is followed step by step, and stress is laid upon the essential antagonism between the processes involved in ordinary evolutionary progress on the one hand, and social progress, with its altruistic obligations, on the other :—

"Men in society are undoubtedly subject to the cosmic process. As among other animals, multiplication goes on without cessation, and involves severe competition for the means of support. The struggle for existence tends to eliminate those less fitted to adapt themselves to the circumstances of their existence. The strongest, the most self-assertive, tend to tread down the weaker. But the influence of the cosmic process on the evolution of society is the greater the more rudimentary its civilization. Social progress means a checking of the cosmic process at every step, and the substitution for it of another, which may be called the ethical process; the end of which is not the survival of those who may happen to be the fittest, in respect of the whole of the conditions which may obtain, but of those who are ethically the best."

This lecture which, printed as a pamphlet, had a very wide circulation, gave rise to an extraordinary amount of misapprehension, and many seemed to think that Huxley had entirely altered his views as regards evolution, ethics, and even theology. In order to show the groundless nature of such ideas, and also to supplement utterances made under somewhat cramping limitations, a "Pro-

legomena" was added the following year to the reprint of the lecture included in Vol. IX. of the *Collected Essays* (p. 1), and this is longer than the lecture itself. Its final paragraph runs :—

“That which lies before the human race is a constant struggle to maintain and improve, in opposition to the State of Nature, the State of Art of an organized polity; in which, and by which, man may develop a worthy civilization, capable of maintaining and constantly improving itself, until the evolution of the globe shall have entered so far upon its downward course that the cosmic process resumes its sway; and, once more, the State of Nature prevails over the surface of our planet.”

A month at Maloja in the summer went far to remove the after effect of influenza. In the course of numerous visits Huxley had become the centre of a circle of warm friends and admirers, who afterwards caused a block of granite to be placed as a memorial by the side of one of his favourite walks, with the following inscription :—

“In memory of the illustrious English Writer and Naturalist, Thomas Henry Huxley, who spent many summers at the Kursaal, Maloja.”

The happiness of the year was later on marred by the deaths of three intimate friends, Sir Andrew Clark, Jowett, and Tyndall, and the complete breakdown in health of Romanes. The loss of Tyndall, more a brother than a friend, was felt with singular acuteness. Huxley attended the funeral at Haslemere on December 9, and wrote an appreciation for the *Nineteenth Century*.

Before leaving 1893, it must be noticed that the work of the year included editing and writing prefaces to Vols. II. III. IV. and V. of the *Collected Essays*, respectively entitled—*Darwiniana*, *Science and Education*, *Science and Hebrew Tradition*, and *Science and Christian Tradition*.

Other labours, not destined to be accomplished, were also in contemplation, especially a full consideration of post-Darwinian speculation, and a series of Working-Men's Lectures on the Bible.

1894.

Huxley attended the British Association in August, held this year at Oxford, the presidential address being given by Lord Salisbury, Chancellor of the University. A very special interest naturally attached to the occasion, seeing that the last meeting held in the same centre was in 1860, when the then Bishop of Oxford so fiercely attacked the theory of evolution. As Huxley himself says, in a letter to Professor Lewis Campbell (dated August 18, 1894):—

“It was very curious to me to sit there and hear the Chancellor of the University accept, as a matter of course, the doctrines for which the Bishop of Oxford coarsely anathematized us thirty-four years earlier. *E pur si muove*” (Life, ii, p. 379).

Lord Salisbury's address, however, was far from being satisfactory in some respects, and implied that post-Darwinian speculation rendered the theory of evolution of problematic validity. Huxley's particular task was to second the vote of thanks proposed by Lord Kelvin, and how this was done is described by Professor Henry F. Osborn (an old pupil), in his *Memorial Tribute to Thomas H. Huxley* (Trans. Acad. Soc., New York, xv):—

“His situation was an unenviable one. He had to thank an ex-Prime Minister of England and present Chancellor of Oxford University for an address, the sentiments of which were directly against those he himself had been maintaining for twenty-five years. . . . Lord Kelvin (Sir William Thomson) one of the most distinguished living physicists, first moved the vote of

thanks, but his reception was nothing to the tremendous applause which greeted Huxley in the heart of that University whose cardinal principles he had so long been opposing. Considerable anxiety had been felt by his friends lest his voice should fail to fill the theatre, for it had signally failed during his Romanes Lecture delivered in Oxford the year before, but when Huxley arose, he reminded you of a venerable gladiator returning to the arena after years of absence. He raised his figure and his voice to its full height, and, with one foot turned over the edge of the step, veiled an unmistakable and vigorous protest in the most gracious and dignified speech of thanks."

The criticism of the President's address is embodied in a leader, "Past and Present," appearing in *Nature* (November 1, 1894), on the occasion of the semi-jubilee of that periodical's foundation. Huxley also attended and spoke at the *Nature* Dinner, arranged in celebration of the anniversary.

Some time after the death of Darwin a fund had been raised, from which a "Darwin Medal" was biennially awarded by the Royal Society in recognition of biological research. Alfred Russel Wallace was the first recipient, and J. D. Hooker the second. This year the third medal was awarded to Huxley, "for his researches in biology and his long association with Charles Darwin." Although after the second medal had been given to Hooker, he had expressed a strong opinion to the officials of the Royal Society that in future younger men should be honoured, and not "useless old extinct volcanoes," the appreciation gave great pleasure both to him and his wife, much enhanced by the association involved with the joint discoverer of Natural Selection and the chief botanical supporter of Darwinism. His speech on the subject at the Royal Society Anniversary Dinner was a fine piece of oratory, full of vigour and virility, and giving no hint of the end that was so immi-

ment. The following extracts are taken from the *Times* report:—

“It is forty-three years ago this day since the Royal Society did me the honour to award me a Royal Medal, and thereby determined my career. But, having long retired into the position of a veteran, I confess that I was extremely astonished—I honestly also say that I was extremely pleased—to receive the announcement that you have been good enough to award to me the Darwin Medal. . . . In reflecting upon what had been my own share in what are now very largely ancient transactions, it was perfectly obvious to me that I had no such claims as those of Mr. Wallace. It was perfectly clear to me that I had no such claims as those of my life-long friend, Sir Joseph Hooker, who for twenty-five years placed all his great sources of knowledge, his sagacity, his industry, at the disposition of his friend Darwin. And really, I begin to despair of what possible answer could be given to the critics whom the Royal Society, meeting as it does on November 30, has lately been very apt to hear about on December 1. Naturally there occurred to my mind that famous and comfortable line, which I suppose has helped so many people under like circumstances, ‘They also serve who only stand and wait.’ I am bound to confess that the standing and waiting, so far as I am concerned, to which I refer, has been of a somewhat peculiar character.”

Here follows the story of the Quaker who only consented “to stand and wait” at the gangway, when a merchant ship was attacked by pirates, using the sharp end of his pike with the remark, “Friend, keep on board thine own ship.” Huxley interprets his “standing and waiting” in defence of the *Origin of Species* as having been conducted on the same principle:—

“ . . . I am sincerely of the opinion that the views which were propounded by Mr. Darwin thirty-four years ago may be understood hereafter as constituting an epoch in the intellectual history of the human race. They will modify the whole system of our thought and opinion, our most intimate convictions. But I do not know—I do not think anybody knows—whether the

particular views which he held will be hereafter fortified by the experience of the ages which come after us ; but of this thing I am perfectly certain, that the present course of things has resulted from the feeling of the smaller men who have followed him that they are incompetent to bend the bow of Ulysses, and in consequence many of them are seeking their salvation in mere speculation."

A further quotation from the speech, summarizing Darwin's character and methods, has elsewhere been given (*cf.* p. 165).

The literary work for 1894 includes, in addition to the "Prolegomena" to the reprint of the Romanes Lecture (*cf.* p. 234), the Prefaces to Vols. VI-IX of the *Collected Essays*, respectively entitled—*Hume, with Helps to the Study of Berkeley*; *Man's Place in Nature*; *Discourses, Biological and Geological*; and *Evolution and Ethics, and other Essays*.

It is of incidental interest to learn that, as might have been expected in so brilliant a writer, his admiration of German scientists does not extend to their average style. For in a letter to Mr. Thomas Common (dated March 23, 1894) he says:—

"As men of research in positive science they are magnificently laborious and accurate. But most of them have no notion of style, and seem to compose their books with a pitchfork" (*Life*, ii, p. 360).

He also accomplished the difficult and delicate task of writing, at the request of the author, a chapter on "Owen's Position in Anatomical Science," in the *Life of Sir Richard Owen*, by his grandson, the Rev. Richard Owen (*Sci. Mem.*, iv, xxxviii, p. 658).

This does full justice to the many and valuable contributions to science made by Owen, more particularly in comparative anatomy and palæontology:—

"It is a splendid record ; enough, and more than enough, to

justify the high place in the scientific world which Owen so long occupied. If I mistake not, the historian of comparative anatomy and of palæontology will always assign to Owen a place next to, and hardly lower than, that of Cuvier, who was practically the creator of those sciences in their modern shape; and whose works must always remain models of excellence in their kind. . . .”

Owen's contributions to “philosophical anatomy” are shown to be of far less value, though even here it is high praise to say :—

“The theory of the continuity of germ-plasm of Weismann, for example, is practically the same as Owen's, if we omit from the latter the notion that the endowment with ‘spermatic force’ is the indispensable condition of proliferation.”

The sketch of the history of anatomical science given in this chapter is of absorbing interest, and many passages are striking on account of the ideas contained, or their beauty of style, or both. Thus, of flowers :—

“Flowers are the primers of the morphologist; those who run may read in them uniformity of type amidst endless diversity, singleness of plan with complex multiplicity of detail. As a musician might say, every natural group of flowering plants is a sort of visible fugue, wandering about a central theme which is never forsaken, however it may, momentarily, cease to be apparent.”

Of Goethe's character :—

“Like all the really great men of literature, Goethe added some of the qualities of the man of science to those of the artist, especially the habit of careful and patient observation of Nature.”

And of those Science needs or does not need :—

“Science has need of servants of very various qualifications; of artistic constructors no less than of men of business; of people to design her palaces and of others to see that the materials are sound and well fitted together; of some to spur investigators

and of others to keep their heads cool. The only would-be servants, who are entirely unprofitable, are those who do not take the trouble to interrogate Nature, but imagine vain things about her; and spin, from their inner consciousness, webs, as exquisitely symmetrical as those of the most geometrical of spiders, but, alas! as easily torn to pieces by some unconsidered bluebottle of a fact."

1895.

Huxley's last work partly had reference to the question of a University for London, and partly consisted of a review on Mr. A. J. Balfour's book on the *Foundations of Belief*. Of this the first half, "Mr. Balfour's Attack on Agnosticism," appeared in the *Nineteenth Century* for March, but his last illness prevented completion of the second part.

Influenza and bronchitis attacked him in March, the unusually severe winter emphasizing their effect. Although successfully thrown off, as such, they led to heart trouble and other complications, which ultimately proved fatal on June 29. The funeral took place at Finchley, on July 4, and the reading of the service by Mr. Llewellyn Davies constituted the only ceremony. In accordance with his expressed desire, three lines from a poem by his wife were added to the formal inscription on the tombstone:—

“ Be not afraid, ye waiting hearts that weep ;
For still He giveth His beloved sleep,
And if an endless sleep He wills, so best.”

CHAPTER XXI

CHARACTER AND POSITION AMONG CONTEMPORARIES

THE many-sided character of Huxley's work renders it singularly difficult to form a just conception of his position among the great men of his day, and the estimate must necessarily differ according to the point of view. Only a symposium of specialists could do him full justice, but as many competent authorities of different kind have expressed their opinions, it will be possible by quoting from some of them to do something by way of correlation.

As to personal characteristics, much will have been gathered from the preceding chapters, in which, so far as possible, Huxley has been made to speak for himself. The following portrait by the Hon. George C. Brodrick, late Warden of Merton College, Oxford, sketches the more salient features in an admirable way :—

“To me his whole nature, intellectual and moral, presented a singular unity; both elements appeared to be in perfect harmony with each other, and the distinctive note of both was the combination of strength with simplicity. From this source was derived the manly dignity of his bearing, the uncompromising directness of his thought, and the enviable lucidity of his style. No subtle analysis is needed to explain his character, the beauty of which consisted in being completely natural, and much that he says of David Hume, in one of his essays, might be applied with equal justice to himself. He possessed in a high degree that rare but open secret to which General Gordon owed so much of his marvellous influence; he was always himself, the same to young and to old, to rich and to poor, to men and to women, and had his lot been cast like Gordon's in Asia or in

Africa, he would doubtless have been the same to Orientals as to Europeans. He was frank, because he was fearless; he inspired confidence because he was evidently a true-hearted man; his native self-respect was set off by a respectful manner towards others; his intolerance of sophistry sometimes betrayed him into undue vehemence in controversial writing, but there was no pettiness in his *odium scientificum*, and a pure love of truth shone through all his most trenchant diatribes, political or theological. As I shared most of his convictions on politics, we talked over such questions without reserve, but I forbore, and never had occasion, to discuss with him questions concerning religious doctrine. I have, therefore, no right to speak from personal knowledge of his attitude towards them. I cannot doubt, however, that whatever his creed, his inner life was that of a good Christian, and that his hopes went beyond his beliefs, though he was too honest to mistake hopes for beliefs or beliefs for demonstrations. Assuredly, with all his apparent leaning to materialism, and rigorous avoidance of sentiment in reasoning, he inherited and even cultivated the precious gift of philosophical imagination. Of him, as truly as of Lyell, it might be said, in the picturesque language of Dean Stanley, that he chose for himself, and courageously pursued, that perilous and lofty path which the vulture's eye has not seen nor the lion's whelp hath trodden—the path which leads upward from ascertained facts and inferences mis-called 'laws,' into the sublimer regions of speculation, where the mysteries of Theology, Metaphysics, and Natural Science mingle and lose themselves, it may be, in the dim confessions of Agnosticism, or, it may be, in the dim aspirations of faith" ("Professor Huxley: Personal Reminiscences," *Fortnightly Review*, New Ser., lviii, 1895, p. 310).

A still more intimate portrayal is given by Sir Michael Foster in the concluding paragraph of an obituary notice:—

" . . . those who had the happiness to come near him knew that besides science and philosophy there was room in him for yet many other things; they forgot the learned investigator, the wise man of action, and the fearless combatant as they listened to him talking of letters, of pictures, or of music, always wondering which delighted them most, the sure thrust with

which he hit the mark whatever it might be, or the brilliant wit which flashed around his stroke. And yet one word more. As an object seen first at a distance changes in aspect to the looker-on who draws nearer and yet more near, features unseen afar off filling up the vision close at hand, so he seemed to change to those who, coming nearer and nearer to him, gained a happy place within his innermost circle; his incisive thought, his wide knowledge, his sure and prompt judgment, his ready and sharp word, all these shrunk away so as to seem but a small part of him; his greater part, and that which most shaped his life, was seen to be a heart full of love which, clinging round his family and his friends in tenderest devotion, was spread over all his fellow-men in kindness guided by justice" ("A Few More Words on Thomas Henry Huxley," *Nature*, liii, 1895, p. 320).

A careful review of Huxley's written works brings out one very striking point, the comparatively early age at which intellectual maturity was attained. The direction of his life's activity and, broadly speaking, his general attitude towards science and education, were clearly defined by the time he had secured a foothold in the scientific world, when an average man would still have been very largely in the making. And when, in his closing years, he edited his *Collected Essays*, surprisingly little was found to alter. The last period in his life, it is true, marks an increasing interest in social and ethical affairs, but this was largely the result of the debarment from active research which physical disabilities made necessary.

When all those who came under the spell of Huxley's virile and convincing personality have passed away, when the controversial matters in which he played so prominent a part belong to ancient history, his claim to a prominent position among the great men of the Victorian era will, in all probability, chiefly depend upon the inestimable value of his astonishingly numerous contributions to scientific research. Prof. A. Kowalewsky well remarked,

if a little emphatically, at the International Congress on Zoology in 1895:—

“ In the person of Huxley, science has sustained a great loss. We do not know any other investigators of our century who had the talent of foresight to such an extent as Huxley. It was he who, properly speaking, founded modern embryology by demonstrating the homology of the germinal layers of Vertebrates with the ectoderm and endoderm of Coelenterates. It was he who supported Darwin in the publication of the fundamental work on the origin of species, and it was he who was the fervent propagator of the views therein contained. The two names of Darwin and Huxley have built up the story of the scientific world ” (Nature, liii, 1895, p. 651).

Huxley described Sir Richard Owen as one upon whom the mantle of Cuvier had fallen. He himself may be considered as the inheritor of the tradition created by Johannes Müller and Von Baer, the respective founders of comparative morphology and embryology. And it may be added that his work assimilates to that of the former in the keen appreciation of physiology which gives a living interest to the arid facts of anatomy. His standpoint in morphology was not merely static but dynamic. To him an organism was not merely an exquisite piece of machinery, but a machine in motion, an adaptation to a complicated and changing environment, a solution to a series of vital problems.

Unfortunately biological experts alone can assess the value of Huxley's original work, and in a biography intended for the general public it can only be treated in a very generalized way. On the other hand, his controversial writings, lucid to a degree and full of the liveliest interest to all, are eminently suitable for quotation. Hence the danger of a one-sided view as to the place he occupied, a danger which would be non-existent in the case of a less versatile man.

In regard to Huxley's purely scientific research it will be sufficient to say here that a great deal of it was not only valuable but epoch-making. He left his mark on almost every important group of the animal kingdom, and specialist workers with the most diverse interests have built and will continue to build on the foundation he laid. Or rather perhaps the ground-floor, for the foundations were well and truly laid by his predecessors.

Part of his scientific work, as we have seen, consisted in important contributions to anthropology, a branch in which he always took the keenest interest, from the time when, as a young naval surgeon, he devised an impromptu waltz with a native of New Guinea, the direction of this saltatory effort being planned with a view to more detailed knowledge of the domestic economy of an interesting primitive people. And if Huxley's reputation depended merely on his anthropological work, he would be a figure of no small importance. Professor Tylor gives us an interesting glimpse of the part he took in the controversial side of this subject:—

“Many who were present still remember with amusement a scene at the British Association meeting at Exeter, in 1869, when Anthropology, then represented by a sub-section of biology, drew dense crowds assembled to hear the anthropologists have it out with the parsons. A theologico-metaphysical attempt to sweep away the development-theory before a gale of declamatory appeal to orthodoxy, backed by the irrefutable combination of intuition and the evidence of sensation, brought up Huxley. With calm seriousness he performed the familiar experiment of touching the tip of his nose with his crossed fingers, inviting his delighted audience thus to satisfy themselves that each of them had two noses, unless indeed they were willing to admit that the systematic comparison of observations, which is called science, had something to do with the formation of a reasonable judgment” (“Professor Huxley as Anthropologist,” *Fortnightly Review*, New Ser., lviii, 1895, pp. 311-2).

The advancement of the theory of Natural Selection by Darwin and Wallace had a momentous influence on Huxley's career, and greatly modified the character of his scientific work. Enough on this subject has elsewhere been said, though emphasis must be laid on the altogether disinterested and non-partizan character of his support. The matter is thus summarized by Prof. Ernst Haeckel, who in some respects played the same part in Germany as regards evolution that Huxley did in England:—

“ Thomas Huxley belonged to that small number of far-seeing naturalists who, from the very beginning, saw the epoch-making import of Darwin's work of research carried on through fifty years, and who with unselfish devotion worked out the detailed application of his theories and aided their application. The pre-requisites for such work were not only an extensive and thorough knowledge in all fields of biology and a clear sagacity of judgment, but also that moral courage which, regardless of consequences, assails a ‘mountain of prejudices’ many thousand years old, and seeks truth for its own sake. As long as Darwin lives as a reformer in the history of biology, so long will Huxley be celebrated as one of his most faithful friends and most successful fellow-workers” (“ Thomas Huxley and Karl Vogt,” *Fortnightly Review*, New Ser., lviii, 1895, p. 469).

It is however noticeable that though Huxley's researches greatly strengthened the foundations of Darwinism, especially on the palæontological side, he can scarcely be said to have made any contributions to the theory of evolution, unless his views on homotaxis may be regarded as such. But, after all, this is not remarkable. Considering that his character was fully formed, and no mean share of his original work accomplished before the publication of the *Origin of Species*, it is astonishing, and reflects the greatest credit on his insight and judicial power, that the rest of his career should be so profoundly

influenced by the new doctrines. He may be regarded as a Darwinian who, without ceasing to carry on the tradition created by Johannes Müller and Von Baer, subjected it to the vivifying influence of evolutionary theory.

Only second to his work as a professional scientist and champion of Darwinism, come Huxley's manifold labours in the cause of education. The methods adopted in modern biological teaching are based on his, which initiated a new epoch and replaced much that was desultory and superficial. As a professor, his lectures were ideal, and had his many duties permitted him to give more of his own time to laboratory supervision, his fame as a teacher would have been even greater.

It has often been regretted that his many-sided activities absorbed the energy that would have enabled him to found a school of scientific workers, actively engaged in original research, as such a man would have assuredly done in such a country as Germany. But this was not to be; there were other things to be done that he deemed of greater importance, and for which he appears to have cared more. Considering that he himself was an investigator of unrivalled keenness and ability, this would seem a little singular. It is however certain that surprisingly few of his many pupils have attained even to moderate distinction. But to this it must be added that the system adopted in the Royal College of Science did not lend itself to the making of specialists, besides which so many of his students were scarcely the right material for such a purpose. Had Huxley been an University professor, the results of his teaching would probably have been very different. It would be difficult, however, to overestimate the results of his methods.

His influence on elementary education was immense, and secondary instruction is also greatly indebted to him.

Nor must we forget his labours in the cause of medical and technical education. In all cases his attention was primarily directed to main principles, details came afterwards. And though he warmly and successfully advocated the claims of natural science, he was fully alive to those of other studies, and to the importance of proportion and perspective in every educational scheme. The systems of these later days would be greatly improved by a strong infusion of that wisdom for which Huxley was pre-eminent.

As a popular lecturer he did much to disseminate a knowledge of and create an interest in biological science among lay audiences, and the high level he attained in such efforts was partly the result of taking them seriously. Eloquence was associated with lucidity and strict scientific accuracy with imagination. The *American Addresses* were perhaps the most notable of such utterances. The numerous courses of lectures to working-men were masterpieces of their kind, and gave him as much pleasure in the delivery as the audience in the hearing. Nor is this surprising, for during the whole of his career his warmest sympathies were with the working-classes, an attitude known and appreciated by them. This is well illustrated by an anecdote narrated by the late Prof. Mivart :—

“I recollect going with him and Mr. John Westlake, Q.C., to a meeting of artizans in the Blackfriars Road, to whom he gave a friendly address. He felt a strong interest in working-men, and was much beloved by them. On one occasion, having taken a cab home, on his arrival there, when he held out his fare to the cabman, the latter replied, ‘Oh no, Professor, I have had too much pleasure and profit from hearing you lecture to take any money from your pocket—proud to have driven you, sir’” (“Reminiscences of T. H. Huxley,” *Nineteenth Century*, December 1897).

Another striking incident is recounted by Mr. Raymond Blaythwayt :—

“ Only to-day I had a most striking instance of sentiment come beneath my notice. I was about to enter my house, when a plain, simply-dressed working-man came up to me with a note in his hand, and touching his hat, he said, ‘ I think this is for you, sir,’ and then he added, ‘ Will you give me the envelope, sir, as a great favour?’ I looked at it, and seeing it bore the signature of Professor Huxley, I replied, ‘ Certainly I will ; but why do you ask me for it?’ ‘ Well,’ said he, ‘ it’s got Professor Huxley’s signature, and it will be something for me to show my mates and keep for my children. He have done me and my like a lot of good ; no man more’ ” (“ The Uses of Sentiment,” *Pall Mall Gazette*, September 20, 1892).

In summing up the good work done by Huxley for the cause of science, it must not be forgotten that besides being an investigator, teacher, lecturer, and writer, he also contributed to the advancement of Fisheries in his capacity as an inspector, and discharged a long series of arduous duties as a member of numerous Royal and other Commissions.

It is obvious that as a thinker Huxley was profoundly influenced by some of the great philosophers in whose writings he was so deeply read. On this point Mr. George W. Smalley says :—

“ In truth he was a very expert metaphysician, with an extraordinary knowledge of the literature of metaphysics and philosophy. . . . Huxley was a student, and more than a student of Descartes. He has written the best short book in existence on Hume. He was a pupil of Aristotle, and therefore not a Platonist. Hobbes taught him much ; Berkeley was to him a great thinker ; Locke, Butler, and the short list of really great names in English philosophy were all his familiars, while among the great Germans there was, I think, none whom he did not know well—Kant, Hegel, Fichte, and all that illustrious line, not excepting Schopenhauer ” (*Scribner’s Magazine*, October 1895).

In an analysis of Huxley's philosophical position, Mr. W. L. Courtney has some interesting things to say ("Professor Huxley as Philosopher," *Fortnightly Review*, New Ser., lviii, 1895, p. 317). His earlier and later writings are compared, and the conclusion reached that in the final period of his life,—

“. . . his large, cultivated, and sympathetic mind could appreciate problems removed from the mental discipline of his earlier years."

And finally :—

"It may, or may not be, more convenient and helpful to represent everything in accordance with a materialistic notation, from the point of view of the progress of knowledge, but what are we to do when the data of our science utterly refuse to be thus represented? How can the man who combats the cosmic process, and carves out for himself a moral code in the teeth of all that nature tells him, be represented by merely materialistic formulæ? When Kant wrote the *Critique of Pure Reason*, he was, if we like to phrase it so, an Agnostic; but he added the *Critique of the Practical Reason*, in which the problems of the understanding were resolved by the reason. Is it possible that, if Professor Huxley had carried out to their logical development the thoughts involved in his Romanes Lecture, he, too, would have supplemented, let us say, *The Physical Basis of Life*, by an ethical theory, reposing on very different foundations?"

Prof. Ernst Haeckel (op. cit.) acknowledges the debt which monistic philosophy owes to Huxley, and also speaks of his work in regard to the evolution of ethics :—

"Of high interest are the researches which Huxley, as 'practical philosopher,' made in the relationship of the modern doctrine of evolution to the great social and political problems of our age. Partly he here arrives at entirely different conclusions from those of his old friend, the famous 'Darwinian philosopher,' Mr. Herbert Spencer. A short time ago Dr. Alexander Tille,

in his excellent book on evolutionary ethics (*Von Darwin bis Nietzsche*, Leipzig, 1895), showed that Huxley's merits in treating evolutionary ethics are principally of a negative kind. Of all the champions in this field Huxley has the most unflinchingly exposed and the most pungently criticised the current *à priori* assumptions of ethical speculation. In two excellent essays on the 'Natural Inequality of Men,' and on 'Natural and Political Rights,' he broke to pieces the favourite doctrine of Rousseauism and socialism—the equality of all men and the belief in inborn 'natural rights,' and dethroned and crushed the state ideal of that political school. With pitiless logic he proved that the alleged facts on which that school bases its doctrines are no facts at all, but wild speculations. Huxley arrives thus at the conclusion, that the aims of current morality cannot, as Spencer thought they could, be reached by the natural medium of competition."

Of Huxley's contributions to critical theology, highly controversial for the most part, as he himself regretfully admitted, enough has elsewhere been said. Here and there they are perhaps a little too strongly illuminated by flashes of withering wit and biting sarcasm, and he would seem to have underrated the capacity of some of his opponents, Mr. Gladstone more particularly. The "scratches" he inflicted were sometimes more serious than "flesh wounds." But his unsurpassable powers of debate, and his thorough knowledge of authorities, gave him in all cases an undeniable advantage. And we largely owe to him in this country that freedom of speech in matters theological without which progress would be indefinitely postponed.

The work of Huxley's life, carried on with unflagging zeal and undiminished powers almost to the day of his death, is a symmetrical and finished whole. Beginning with primeval protoplasm, the "physical basis of life," it ranges through the long perspectives of the animal kingdom to man as the noblest outcome of organic evolution. To man as an individual, to thinking man as a member of

an organized society, and to man as "Nature's rebel," with deeply implanted ethical and religious sentiments, waging continual war against the stern realities of the cosmic process.

Huxley's researches as a comparative anatomist and embryologist would alone entitle him to a conspicuous place among his contemporaries. And when to this we add his championship of evolution, his labours in the cause of education, his contributions to sociology and ethics, he stands, an unique figure, among those who brought about that Scientific Renaissance for which the Nineteenth Century will be memorable as long as the human race endures.

APPENDIX

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