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Being the First Sir John Struthers Anatomical Lecture Delivered at the Royal College of Surgeons of Edinburgh, 17th November 1911.

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ARTHUR KEITH, M.D., LL.D., Aberdeen.

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Minto House, the town house of the Elliots of Minto, was converted into a Surgical Hospital by Syme in 1829. About the year 1878 it was demolished, and on its site Mr. Falconer King, an analytical chemist, erected a modern building with accommodation for himself and other extra-mural lecturers. Professor Cossar Ewart gave the first course of Anatomy Lectures (1878-79), and was succeeded by Dr. Johnson Symington in the summer of 1879, who held a lectureship till he was appointed Professor of Anatomy at Queen's College, Belfast, in 1893. He was succeeded by Mr. Alexander Miles, who held the lectureship for two years. Minto House then became the home of the School of Medicine for Women, anatomy being taught there by Dr. J. Ryland Whitaker, until the building was sold and converted into business premises.

The "New School" School of Medicine was founded by a number of extra-mural lecturers in 1894. An anatomical department was built, and Dr. James Musgrove held the lectureship till 1896, when he was appointed Professor of Anatomy at St. Andrews. He was succeeded by Dr. R. J. A. Berry, who held the lectureship till 1905, when he went to Melbourne as Professor of Anatomy. The Anatomical Department in the New School was then leased to the University, and is still used as an annex of the Anatomical Department of the University under Professor Robinson.

ANATOMY IN SCOTLAND DURING THE LIFETIME OF SIR JOHN STRUTHERS (1823-1899).*

BEING THE FIRST SIR JOHN STRUTHERS ANATOMICAL LECTURE DELIVERED AT THE ROYAL COLLEGE OF SURGEONS OF EDINBURGH, 17TH NOVEMBER 1911.

By ARTHUR KEITH, M.D., LL.D., Aberdeen.

MR. PRESIDENT AND FELLOWS OF THE COLLEGE,—On the 20th of February 1899, four days before his death and on the last day of his 76th year, Sir John Struthers added a codicil to his will making provision for the delivery of a lecture on anatomy every third year in connection with this college. In that codicil he associated the subject to which he had devoted 54 years of his life with the college which, in the words of the late Mr. Joseph Bell, "he loved with a passionate and touching devotion." You have bestowed on me, one of his old pupils, the high honour of giving the first lecture.

The lifetime of Sir John Struthers covers one of the most progressive periods in the history of human anatomy. When he began the study of medicine here in 1841 the majority of anatomists were followers of Paley, the theologian; the development of the human embryo was almost unknown; the body was supposed to consist of "textures" and "humours"; the deeper and more vital parts were supposed to lie beyond the surgeon's endeavour; fossil remains of man were unknown. He lived to see all these things change. One by one the anatomists became followers of Darwin the evolutionist, little by little the history of the human embryo

* My chief sources of information have been the following:—The past volumes of this *Journal*, especially those between 1830-1860, where there is to be found not only a full account of the work done by Scottish, but also by French, German and Italian, anatomists; *Natural History Review* (1854-1865); *Journal of Anatomy and Physiology* (1867-1900); *Historical Sketch of the Edinburgh Anatomical School*, by John Struthers, M.D., Edinburgh, 1867 (see also *Edin. Med. Journ.*, 1867, vol. xii. pp. 289, 431, 539); *Letters of Sir Charles Bell to his Brother, George Joseph Bell*, London, 1870 (see also Sir William Turner's extracts in *Journ. Anat. and Physiol.*, 1869, vol. iii. p. 117); *Life and Writings of Robert Knox*, by Henry Lonsdale, London, 1870; *The Anatomical Memoirs of John Goodsir*, edited by William Turner, with a biographical sketch by Henry Lonsdale, 2 vols., Edinburgh, 1868; "An Address on the Occasion of the Opening of the New Home of the Royal Society of Edinburgh," by Sir William Turner, Nov. 1909.

became known and its stages modelled; under the microscope the "textures" were slowly resolved into vital units or cells; the discovery of anæsthetics and of antiseptic methods made even the deepest parts of the body accessible to operation and to investigation; from time to time discoveries were made of fossil remains which extended the origin of man further and further into the past. In the world of human anatomy a revolution had taken place, and in that revolution we shall see that Scotland played her part and had nowhere within her borders a more courageous rebel than the founder of this lecture, Sir John Struthers.

The Anatomists in Edinburgh in 1841.

In surveying the men in Scotland who were making a special study of the human body when John Struthers, as a Dunfermline youth of 18, commenced the study of medicine here in 1841, there is no need to go beyond the bounds of Edinburgh. The professor of anatomy in Glasgow was merely marking time; the chairs at St. Andrews and at my own college, Marischal College, Aberdeen, were then being filled by men from this school. The Scottish anatomists were centred in Edinburgh; only Berlin and Paris could show a group of workers that could stand a comparison with the men then in the Scottish capital. In the University there were Sir Charles Bell, then a man of 67, a surgeon by profession but an anatomist at heart; Alexander Monro, the third of his dynasty, also a man of 67, the professional anatomist in the University; James Spence, his demonstrator, aged 29; James Y. Simpson, newly appointed to the Chair of Midwifery, and, although only in his 30th year, already widely known as an anatomist. Outside the University, grouped round Surgeons' Square, making a livelihood as best they could, were Robert Knox, aged 51, one of the most gifted and wayward of Edinburgh's sons; Allen Thomson, aged 32, just returned from Aberdeen; Dr. Hughes Bennett, and many more of whom I need only mention two—Dr. Peter David Handyside, medical missionary, surgeon, and anatomist, aged 33, and Dr. Henry Lonsdale, the biographer and historian, then in his 25th year. Last and greatest comes John Goodsir. In 1841, at the age of 27, he gave up assisting in his father's practice at Anstruther, and was appointed by this college conservator of its museum, in succession to "the accurate MacGillivray," as Darwin named him, who had been appointed to the Chair of Natural History in Marischal College, Aberdeen.

These were the anatomists in Edinburgh when Struthers commenced his career.* In his first year he studied anatomy with Allen Thomson; in the following year (1842) Allen Thomson was appointed to the Chair of Institutes of Medicine in the University, and Struthers went to a new school, formed by Handyside, Spence, and Lonsdale. There we shall see that he became heir, not only to the traditions of the Knox school, but also to part of Knox's museum.

Charles Bell.

Never in the whole history of medicine were two men so opposite in character brought face to face in one place and at one time as Charles Bell and Robert Knox. In 1841 their suns were setting; in 1842 Sir Charles Bell died and Robert Knox had to leave the lime-lights of Edinburgh to lead the life of a wandering Ishmaelite. Our business is merely to see what they did to increase our knowledge of the structure of the human body, and, as far as concerns Sir Charles Bell, the story is soon told. He found, soon after he left Edinburgh (1803) and started a venture school of anatomy in London, that men could give no reasonable explanation of the division of our central nervous system into cerebrum, cerebellum, and spinal cord, nor could they explain the

* Sir John Struthers was born on 21st February 1823 at Brucefield, a small estate now on the northern outskirts of Dunfermline. His father was a prosperous flax-spinner. The writer visited Brucefield last autumn. The house stands on a knoll amongst trees, and the additions which were made to it in the early part of last century show that its owner must have had command of money. The old flax-mill is used as farm buildings by the present tenant. Sir John Struthers as a student was in easy circumstances when compared with the majority of his contemporaries. He was educated at home, and was for a few months in business. He was turned towards medicine by reading *The Constitution of Man*, by George Combe, a disciple of Spurzheim, the phrenologist. When George Combe died he left a request that Dr. Struthers should examine his brain—a request which was carried out under peculiar difficulties. Beginning his studies in 1841, Sir John Struthers graduated in 1845, and went to London on a visit. He was recalled by Dr. Handyside and Mr. Spence to take Lonsdale's place in the extra-mural school at No. 1 Surgeons' Square. He borrowed £250 from his father and took his fellowship of the College of Surgeons. In 1846 Spence retired, Handyside and Struthers going to 11 Argyle Square; in 1847 Handyside retired, leaving his partner with his museum and sole extra-mural teacher in anatomy. In 1849 the extra-mural teachers concentrated in Surgeons' Hall. In forming this school Sir John Struthers took a leading part. He remained with it until he went to Aberdeen in 1863. In 1854 he was appointed assistant surgeon to the Royal Infirmary.

remarkable and apparently meaningless manner in which the nerves arose and were distributed. He laid hold of a basal fact; he realised that if he could discover the uses of the various parts of the nervous system he could explain the complexity of their arrangement. His merit lies, not in making a reasonable guess as to the function of cerebrum, cerebellum, double nerve roots and double nerve supply, but in having made this guess from his knowledge of human anatomy; he proceeded to test its truth on the bodies of other animals by dissection, and above all by experiment. His reputation as a discoverer does not rest on a quibble as to who discovered the exact function of the nerve roots, but on the fact that he was the first man that realised that the anatomy of our brain and nerves could be explained. In 1841 he could see that the movement which he had initiated had extended to Paris, to Berlin, London, and Edinburgh. The investigation which John Reid had carried out in 1838 on the function of the 9th, 10th, 11th cranial nerves,* and the research on the same nerves which James Spence† had then on hand, were direct results of Bell's work. His simple conception of the origin of man assisted him in his researches. He was a convinced and devout follower of Paley, regarding the human body as a special creation of marvellous design, and believing that the working of its parts could be discovered by studying their arrangement. In brief, he was a teleologist.

Robert Knox.

Knox's services to anatomy were of a very different nature. During the sixteen years he earned a livelihood by teaching anatomy in Surgeons' Square he carried out many and valuable researches in human and comparative anatomy. Modern and fresh as these still are, it is not because of them that we remember him, but because he was the chief agent by which a revolution was effected in the minds of Scottish anatomists concerning the nature of the human body. So potent was Knox's influence on the history of anatomy in Scotland that we must look for a minute at a critical phase in his life. In 1822, when he had retired from the Army Medical Service and was in his

* *Edin. Med. and Surg. Journ.*, 1838, vol. xlix. p. 109, "Experimental Investigation into the Functions of the 8th Pair of Nerves, etc.," by J. Reid, M.D., Lecturer on the Institutes of Medicine, formerly Demonstrator of Anatomy.

† *Edin. Med. and Surg. Journ.*, 1842, vol. lviii. p. 397.

31st year, he paid a visit to Paris, and found Cuvier and Geoffroy St. Hilaire in the full tide of their fame. When he returned to Edinburgh his Covenanter's soul glowed with the ideals and discoveries of the great Frenchmen. He now viewed the human body, not as a special creation, but as part of that great plan in which Nature had fashioned all vertebrate animals, past and present. Those phrases with which we are now so familiar came into use—"rudimentary structures," "arrested development," "recapitulation by the embryo of ancestral stages," and "homologous structures." The anatomist's ideals were changed. It was no longer his aim to discover the functional significance of parts, but to ascertain the plan on which the body was formed and the type from which its individual parts had been evolved. Knox was only the apostle, not the originator, of this doctrine. His master, the lovable Dr. Barclay, had paved the way for him, and everyone knows how Owen developed morphology afterwards in England. Knox jeered at the "special creationists" when orthodoxy was really strict in Scotland; he scoffed at the "coarse utilitarianism of Paley, by which Sir Charles Bell stood;" he flouted those who regarded "anatomy as an appendage of surgery." He declared there was no real school of anatomy except in France, that there had been no great anatomist in London except John Hunter, and he invariably spoke as if there were none in Edinburgh except himself. He was a century before his time, and had to pay the price of his genius and his failings. By 1841, when he had passed his 50th year, he found he had outstayed his welcome in Edinburgh. He became the King Lear of anatomists; but we shall see that his influence remained behind him and bore fruit for many generations after he had gone.

Alexander Monro (Tertius).

We must turn for a minute to Alexander Monro, who held the Chair of Anatomy in the University during the time John Struthers was a student. Indeed Struthers himself had commenced to teach anatomy when, in 1846, Monro resigned at the age of 72, after having taught anatomy in the University for 48 years. If we accept the verdict of his contemporaries, that he was an incompetent teacher and that his dulness was the virtue which gave Edinburgh the great extra-mural school of Barclay and Knox, we shall show but a meagre understanding of either the man himself or of the events which were shaping

then in anatomy. The truth is, he had outlived his period. He had ideals. From the numerous researches and books which he published we can see that he studied the anatomy of the human body with two objects: (1) in order that surgeons might operate on it with dexterity; (2) to note the disturbances caused in it by disease, so far as these could be brought to light by knife and forceps. These were the ideals which Allan Burns of Glasgow and Matthew Baillie of London had made popular in Monro's more youthful days. It was not because of his ideals he failed, it was because he was content to play the local tunes of his younger days while Knox was setting the youth of Edinburgh agog with a music which was then thrilling Europe. He failed in the first duty of a professor, the duty of bringing students in touch with the best movements of the time.

The Younger Anatomists.

Having thus summarily dismissed the three senior men who were directing the destinies of anatomy in Scotland at the beginning of Struthers' career, we come face to face with one of the most wonderful groups of young investigators ever produced by Edinburgh, or by any other capital of Europe. Only three of them come directly into this history—Allen Thomson, Hughes Bennett, and John Goodsir; the other members of the group were—John Reid, James Y. Simpson, William Sharpey, T. Wharton Jones, Harry Goodsir, Hugh Falconer, Edward Forbes, Martin Barry, and W. B. Carpenter. Each of these played a part, directly or indirectly, in forwarding our knowledge of the human body. With one exception—Allen Thomson, a son of the Professoriate—they were pupils of Knox. It would take us too far afield to trace the sources of their inspiration; it is enough to note that through Edinburgh they took, not a local but a cosmopolitan position amongst the pioneers of their time. Wm. Sharpey, who passed as an anatomist in Edinburgh, founded the School of Physiology at University College, London. Amongst those whom he influenced were Michael Foster and Burdon Sanderson, the founders of the Physiological Schools at Cambridge and at Oxford Universities; the distinguished occupant of the Chair of Physiology of this University, Professor Schaefer, is also a pupil of his. Wharton Jones set Huxley out on his great career, and one has only to turn to the brilliant researches which Lord Lister carried out in his youthful days to see how directly Wharton Jones was his godfather in science.

RESEARCHES OF THE YOUNGER ANATOMISTS—EMBRYOLOGY.

We now proceed to see the form which anatomy is to take in the hands of the younger men. In the autumn of 1841 Allen Thomson * was earning his living by teaching anatomy to students at No. 1 Surgeons' Square. John Struthers attended his class. He had just exchanged places with Alexander Lizars, Thomson returning to Edinburgh and Lizars going to Aberdeen. He was the first in Scotland to apply himself to the study of the early stages in the development of the human embryo. When he graduated in 1830, at the age of 21, he read an account of his observation on the formation of blood-vessels in the mammalian embryo as his thesis for the degree of Doctor of Medicine. The microscope had then reached a degree of proficiency—thanks in no small measure to the inventive genius of Joseph J. Lister, the father of Lord Lister—thus making it possible to investigate the finer anatomy of embryos. After graduation, as was the habit of the more brilliant students, he visited the Continent, and made himself familiar with the men and movements in Paris and in the rising schools of Germany. In 1824 Rathke of Dantzig had noted the gill clefts in the embryo of the sheep; in the same year Purkïnje of Breslau had discovered the ovum of the bird; two years later von Baer found the ovum of the dog. Allen Thomson appeared at a time when the history of the embryo was occupying the attention of anatomists on the Continent; he domiciled that movement in Scotland. In 1839 his most important paper appeared in the pages of the *Edinburgh Medical and Surgical Journal*.† It is a description of two very early stages in the development of the human embryo. One of these embryos he had obtained from his friend, John Reid. Little was then known of these very early stages. The only men who had already seen and described equally young specimens were his Edinburgh contemporary, Wharton Jones, and young Coste of Paris. Forty years later, when Professor His of Leipzig commenced to systematise our knowledge of the early stages in the development of the human body, he found Allen Thomson's records amongst the few which had an abiding value. Allen Thomson was not the only one of the young Edinburgh group who had studied abroad and joined in the embryological movement. Mention has been made of

* Obituary Notice by Sir John Struthers, *Edin. Med. Journ.*, 1884, vol. xxix. p. 1151; Obituary Notice by Professor M'Kendrick, *Proc. Roy. Soc. Lond.*, 1884, p. 24.

† Vol. lii. p. 119.

Wharton Jones; there was a third, perhaps the greatest of the three, Dr. Martin Barry.* It was he who first recognised the spermatozoa within the mammalian ovum and noted the first changes which follow fertilisation. He was an excellent observer, and had that quality of imagination which interprets rightly the significance of things seen. Although three years junior to Thomson as a graduate he was the older man, being at the time of which we write (1841) already in his 39th year. His earlier work was done in Edinburgh, but seeing no sign of obtaining a permanent position there, he set out to find one in 1842, but his search was vain; there was no demand for embryologists in this country at that period. Like Francis M. Balfour, brother of the ex-Premier and the greatest British embryologist of last century, he was a noted Alpinist.

The Microscope—Dr. Hughes Bennett.†

At the beginning of the winter session of 1841-42 another movement was initiated by Dr. Hughes Bennett in Surgeons' Square. After a sojourn of four years on the Continent he returned at the age of 29 to open a private class for the instruction of medical students in the use of the microscope. Hughes Bennett did not introduce that instrument to Edinburgh—it had been in the hands of those carrying out special investigations for more than 10 years. His pioneership lies in the fact that he was the first in Scotland to realise that it was a powerful instrument for medical research, and essential for a real understanding of the structure of the body in health and in disease. Again we are dealing with the expansion of a continental movement, with its chief centre in the Anatomical Department of the University of Berlin. Johannes Müller, the Professor of Anatomy, was then (1841) a man of 40, with a group of young assistants round him —Henle, Koelliker, Remak, Brücke; among his students were Virchow, Helmholtz, and Du Bois Raymond. His assistant was Schwann; his colleague was Schleiden the botanist. Discoveries in the finer structure of the body were of daily occurrence; tissues and organs which to the naked eye seemed uniform material were resolved by the microscope into their structural elements.

* See Sir William Turner's "Cell Theory, Past and Present," *Journ. Anat. and Physiol.*, 1889, vol. xxiv. p. 253.

† See Professor M'Kendrick's account of his life and work, *Edin. Med. Journ.*, 1871, vol. xxi. p. 466.

The immediate cause of the burst of enthusiasm in 1841 was the announcement made by Schleiden and Schwann two years previously, namely, that plants and animals were composed of microscopic units or cells. It was Schwann that unfurled the flag, but it was Johannes Müller that planned the campaign which led to the capture of the position. The real pioneer, however, was William Hewson, who taught anatomy in London with William Hunter in the latter part of the 18th century. Is it not a curious fact that we see Allen Thomson and Hughes Bennett about the end of the fourth decade of the 19th century introducing from Germany movements which were really initiated at a much earlier date in England? For if we count Hewson the pioneer as an anatomical microscopist, we cannot withhold the claims of William Harvey as the pioneer of embryology.

We shall leave Hughes Bennett to teach his class and apply his microscope to the inflammatory changes in the brain, and turn to see what John Goodsir, the young conservator of the College of Surgeons, was doing in 1841.

John Goodsir.

The heart warms to John Goodsir in spite of his tall, sombre appearance and his Calvinistic spirit. He has not been abroad, like the other members of the youthful Edinburgh group, to seek for inspiration, but has found it in his native Firth of Forth with his own eye and with his own brain. As a boy he studied the marine invertebrates of the Firth; they are the animal forms which take the inquirer nearest to the secrets of life. At the very beginning of his student's career in 1831 we find him amongst the subjects laid out in Knox's dissecting-room, instructing Edward Forbes, newly arrived from the Isle of Man, in the anatomy of the Mollusca. They go dredging in the Firth together, then and often afterwards preparing the way for the great "Challenger Expedition," which was to set out under Sir Wyville Thomson 40 years later. Through Knox and by his own reading he learnt what was on foot in the medical centres of France and Germany. His apprenticeship as a dentist—under Nasmyth, one of the best dental anatomists of the time—ended in a research in which he described fully and accurately the various stages in the development of the human teeth, and in which he recognised that the pulp round which the tooth is formed is in reality a submerged dermal papilla. He found later that Arnold of Heidelberg had

anticipated most of his discoveries in 1831. So, too, in 1841, when he had unravelled the anatomy of amphioxus, and determined its intermediate position in the animal kingdom, he found Johannes Müller and Rathke had been making similar researches with corresponding results. It was with a basal training of this nature, a training which involved the study of the simpler forms of life under the microscope, that John Goodsir approached the study of the human body. As conservator in the museum of this college he was brought in contact with the preparation of Barclay's collection, but more especially with the specimens from the museum of Sir Charles Bell, which this college had boldly acquired in 1824. Amongst them were the preparations which William Cruickshank had preserved to illustrate the mouths of absorbent vessels in the villi of the intestine. Goodsir applied his microscope and found that the vessels ended blindly; he observed a carpet of cells between the absorbent vessels and the contents of the intestine, and he concluded that it must be these cells which extract nourishment from the food. John Hunter regarded the smaller vessels as the parts which absorbed bone; William Cruickshank believed he had demonstrated that the lacteals absorbed nourishment from the intestine; it was John Goodsir who discovered that the cells were the real structures concerned in absorption and in excretion. There again he was forestalled by Purkïnje of Breslau. It is not priority that should count when we come to estimate a man; it is the accuracy of his observations and the justice of his inference, and in both of these the process of time has shown that Goodsir was pre-eminent. It is not necessary here to follow his investigations in the microscopic structure of the kidneys in health and in disease, his recognition of the nucleus as the centre of a cell's reproductive power, his identification of *sarcinæ* as a cause of vomiting, and their destruction by the use of creosote. The lesson we may learn from his early career is that the secrets of man's body will not yield to a frontal attack with knife and forceps, as was Monro's method. Those secrets will yield only to those who approach man's anatomy through those simple animal forms where the processes of life are more easily observed.

The Position of Anatomy in 1846.

We pass on to the year 1846. Monro at last had resigned, and Goodsir had succeeded him as Professor of Anatomy in the

University. Dr. Struthers * was by then a fellow of this college and conservator of the museum, having succeeded in that post Harry Goodsir, who perished in Sir John Franklin's expedition. He was then in partnership with Handyside in an extra-mural school of anatomy. It was realised that the appointment of Goodsir presaged a hard time for the extra-mural teachers of anatomy, and so it fell out. The event of the year which most concerns us here is Goodsir's inaugural address. He surveyed with a masterly eye the whole horizon of anatomy and the various periods of anatomical progress, but when he came to his own period—the period which begins with the introduction of the microscope in 1830—he hesitated and confessed that the direction of future progress was obscure. We of a later generation know that movements were at that date already on foot which materially altered the course of anatomy. In 1841 Darwin had settled at Downe, and the first draft of his theory of the origin of species was written in the same year (1841). Robert Chambers, a citizen of Edinburgh, was in retirement at St. Andrews. In the course of supplying useful information for the people he had become aware that the discoveries of Lyell, of Agassiz, of Knox, and of the French School were at variance with the Mosaic account of creation. He spent two years trying to reconcile the conflicting accounts, the result being the *Vestiges of Creation*, published in 1844. It is not necessary to remind my hearers that Hugh Miller was then in Edinburgh. He had familiarised the people

* Sir John Struthers had a successful student's career. In his first year (1841-42) he was first prizeman in Dr. Allen Thomson's anatomy class; in 1842-43 he was again first prizeman in anatomy (Handyside, Spence, and Lonsdale's school), and first in physiology in the University (Professor Allen Thomson); also first prizeman in botany (Professor Graham). In 1843-44 he gained the prize for the best dissection at the extra-mural school; first prize in surgery (Professor Miller); first prize (University) for an essay on "The Movements of the Eyeball in Man, and on Strabismus;" 1844-45, first prize in pathology (Professor Henderson). The great educational value of student societies is seen in his career. In 1843 he joined the Hunterian Medical Society, founded or resuscitated by Knox and Lonsdale (about 1840); Andrew Clark and William Gairdner joined in the same year. His elder brother, James, afterwards the physician of Leith, was elected a member in 1845, and his younger brother, Alexander, who died in the Crimea, joined in 1847, but soon after resigned and joined the Royal Medical Society. Sir John Struthers and Sir William Gairdner became the moving spirits of the Hunterian Society. Sir John Struthers read papers on "Amputation at the Knee and Ankle Joints" (1845); on "Homœopathy" and on "Tracheotomy" (1846); "Phrenology"; "Sulphuric Ether"; "Cell-Development" (1847). The Society became defunct about 1857.—(MS. notes by Sir John Struthers.)

of Scotland with curious worlds of past life which lay buried in the rocks. We see on foot in Edinburgh a movement affecting even the non-professional public which was destined to influence the anatomist, in so far as it completely altered the accepted account of man's origin.

Position of Anatomy in 1863.

We now pass forwards to 1863. That year is chosen because it marks the close of Dr. Struthers's career as an extra-mural teacher of anatomy in Edinburgh, and for the further reason that it provides an excellent opportunity of seeing how the anatomists of Scotland were affected by the *Origin of Species*, which had appeared four years previously. Research in anatomy had by this time spread beyond the bounds of Edinburgh. Allen Thomson held the Chair of Anatomy in Glasgow, having in 1848 given up the Chair of Physiology in this University, which he had occupied for six years; his successor was Dr. Hughes Bennett. His early career promised a front position among the embryologists of Europe, but while his German confrères pressed forwards to discover the secrets of embryonic development, he was content to carry out minor researches and take a leading part in establishing the two great standard works of British Anatomy—*Todd's Cyclopædia* and *Quain's Anatomy*. No school of embryologists arose in Scotland in his time; unfortunately with all his splendid natural endowments he lacked that magnetism which turns pupils into disciples and apostles. John Reid,* the most promising representative of the younger Edinburgh school, died at St. Andrews in 1849, after having held the chair there for eight years. With his premature death—he was only in his fortieth year—the school of Sir Charles Bell—of the Monroes and of the Hunters—the School of Experimental Anatomists—came to an end. In 1850, while holding the Chair of Anatomy at King's College, Aberdeen, Professor Peter Redfern published his classical paper on the microscopic structure of the cartilage of joints in health and disease. The author of that paper is now the Senior Fellow of the Royal College of Surgeons, England, the next in order of seniority being Lord Lister, and is the sole surviving member of that wonderful group of young microscopists—Bowman, Paget,

* *Life of Dr. John Reid*, by G. Wilson, 1852; *Physiological, Anatomical and Pathological Essays*, Edinburgh, 1848. See also account of his life and work by Professor D. Fraser Harris, *Nature*, 5th August 1909, p. 165.

Busk, Gulliver, Quekett and Simon—who studied and worked in London in the early "forties" of last century. In Edinburgh, with Goodsir at the height of his name and fame, matters in the anatomical world had become simplified. Dr. Struthers, as Lecturer on Anatomy at Surgeons' Hall, was the sole representative of the band of extra-mural anatomists who throve in Edinburgh so long as Monro held the chair. Let us see how anatomy prospered between 1846 and 1863 under Goodsir and Struthers.

The Nature of the Early Researches of Sir John Struthers.*

The direction of a young anatomist's research is influenced by the traditions and movements of his time, and to this law John Struthers was not an exception. In 1840 Dieffenbach introduced his operation for squint, which quickly became popular in Europe; in 1841 his teacher of physiology, Professor Alison, published an explanation of why the muscles of the eyeball were supplied with sensory as well as with motor nerves. Hence we find Dr. Struthers's researches are concerned with the muscles and nerves of the eye and with squint. As a student of anatomy in the extra-mural school of Handyside, Spence, and Lonsdale we find him investigating the nerves and muscles of the eye. In 1845, 1849, and 1852 he published papers on the action of the orbital muscles and on the nature of their nerve supply. In these early papers his endeavours are directed to throw light on the normal action of the parts and their disturbances in disease.

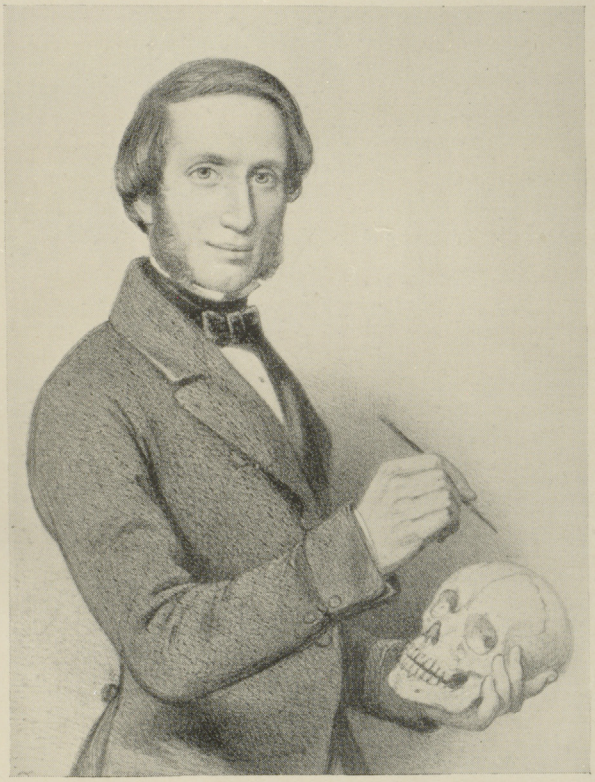
The efficacy of blood-letting was being discussed in the early days of his professional career. We find him investigating how it is possible, or rather impossible, to relieve congestion of the abdominal viscera by drawing blood from the body-wall surround-

* I possess a volume of Sir John Struthers's collected papers from 1845-1889. It was given to me by my friend, Dr. William Bulloch. It contains (1) "Memoir on the Clavicle" (Edinburgh, 1855), the first of a series of osteological memoirs—the only one published. (2) "Anatomical and Physiological Observations" (Part I.), Edinburgh, 1854 (16 papers are included, most of which appeared in the *Edin. Med. Journ.*). (3) "Anatomical and Physiological Observations" (Part II.), Aberdeen, 1864 (6 papers are included). (4) "References to Papers in Anatomy—Human and Comparative," Edinburgh, 1889 (summaries are given of 70 of his published researches). Subsequently to 1889 most of his papers appeared in the *Journal of Anatomy and Physiology* and the *Edinburgh Medical Journal*. His Presidential Address to the Royal Physical Society on "Rudimentary Structures" was published in the *Proceedings* of that Society for 1898.

ing them.* He examined the arrangement of the valves of the jugular veins to see how far blood-letting could relieve distension of the heart in cases of suffocation—a subject which had received the attention of John Reid a few years previously. Although his aim was to use anatomy as a stepping-stone to surgery—and he became assistant surgeon to the Infirmary in 1854—he was at heart an anatomist. Just before he commenced his studies two works appeared—Ward's book on *Osteology* (1838) and Ellis's *Manual of Dissections* (1840)—which had a powerful influence on British anatomists. The authors of these works proceeded on the principle that the business of an anatomist was to give a minute and accurate description of the bones and of the soft parts of the human body, and when they had done that their task was finished. It must be admitted they were successful in their aim; they described the human body in detail and with extreme accuracy. They had a whole-hearted disciple in the young extra-mural lecturer of Edinburgh. In his "Memoir on the Clavicle," published in 1855, we see this ideal being carried into practice—an ideal absolutely at variance with the conception of the Bell school. We can also see that he was influenced by the French school, by Knox, and by Barclay. He became the owner of Knox's specimens, and as conservator of the museum of this college knew Barclay's collection well. The significance of vestigial or rudimentary structures fascinated him from the very beginning of his career. That curious little hook of bone which occasionally occurs on the inner side of the humerus above the elbow joint—the supracondyloid process—had been recognised by Knox in 1841 as the reappearance in man of a structure that occurred constantly in many animals. All through his life Struthers made observations on this process, issuing them as papers in 1848, 1854, 1858, and 1881. His specimens are in the museum of this college to speak for themselves. His inquiry opened out for him not only a series of new observations on the anatomy of the human arm, but he also realised that in this small and apparently insignificant thing much of the past history of man might be revealed. We know very well what he thought of the origin of man in 1857, when he gave a lecture in this college on "The Unity of Organisation." At that time, in common with the leading men of this period, he regarded the human body as a creation, fashioned after the plan which had served as a type or design for higher animals. In man's body some

* See Sir William Turner's observations to the opposite effect: *Brit. and Foreign Med. Chir. Rev.*, July 1863.

(22)



[*From a Lithograph.*

PORTRAIT OF SIR JOHN STRUTHERS IN 1850 (ÆT. 27).

structures were specially developed, and others had become reduced to vestiges. In 1863 we see that his outlook on the animal kingdom and the nature of his researches were changed; he had joined the unpopular Darwinian movement. He now became a student of variation and of heredity. The studies he then made of families possessing extra fingers and toes, or showing abnormal union and other anomalies of the digits, not only afforded evidence in support of Darwin's theories, but constitute permanent contributions to the natural history of mankind.*

We see here another instance of the truth that revolutions in anatomy arise outside the dissecting-room. In this case Darwin the naturalist was the active agent. The "Unity of Organisation" movement came from the biologists Cuvier and Geoffroy St. Hilaire; the doctrine of design from Paley the theologian. At the very date of which we write a French chemist was changing the outlook of all medical men.

The Later Researches of Goodsir.

In 1863 Goodsir had held the chair for 17 years, and there were already signs of the unfortunate illness which, four years later, at the age of 53, was to put an end to a life of vigorous and feverish research. He pursued the secrets of life in manifold directions: on the fauna of his beloved Firth, on electrical organs of fishes, on the development and nature of the glands of internal secretion, and on the mechanics of the human body. Above all he was drawn into the search for the underlying plan or type on which the animal body had been created. In the early years of Goodsir's professoriate Richard Owen was popularising the idea that the skull was made up of a series of fused vertebræ. The theory

* All through life Sir John Struthers kept his mind fresh and open. At a dinner given by the Aberdeen students to Huxley in 1874, after they had made him their Lord Rector, Professor Struthers said: "There is scarcely a thing which I believed in 25 years ago which I believe in now, and in another 25 years I expect it will be also so." Mrs. Niecks, his daughter, has in her possession some interesting letters which passed between Huxley and Sir John Struthers. The latter, Professor Struthers as he then was—he received the honour of knighthood in 1898—had urged the Students' Committee to select Huxley as a candidate, and also pleaded with Huxley to stand. The latter was unwilling on account of health. Huxley then suffered from dyspepsia, with, as he said, "eupeptic intervals." Professor Struthers, who suffered in a similar manner from 1870 onwards, pictured the north of Scotland as suffering from "the old worship of Greek and Latin." He wanted Huxley to help Bain and himself in giving science subjects a better standing in the University of Aberdeen.

has been much discussed since then. Goodsir was the first to show that the key to the problem was to be found in the segmentation of the embryonic head and in the distribution of the cranial nerves. At first sight his researches seem a long way off from applied human anatomy, yet one has only to consider the modern work of Gaskell, of Sherrington, and of Head to see that the time is coming when Goodsir's researches will serve as a basis for clinical practice. When the Darwinian movement commenced, Goodsir, the stern Calvinist, as was also the case with Owen, stiffened his back; he strove to rescue man from the hands of the evolutionists. The lectures on "The Dignity of the Human Body," which he delivered to his class in 1862 as a counterblast to Huxley's lecture in Edinburgh on "The Zoological Position of Man," constitute one of the most searching analyses ever made of the peculiar features of the human body. He went to his end with the anti-evolution flag still flying.

Lister and Turner Arrive.

We have seen that at an early date Edinburgh conferred two of her best men on London—Sharpey and Wharton Jones. In 1854 London repaid her debt with interest; she sent Lister and Turner. William Turner, a young man of 24, a favourite pupil of Sir James Paget at St. Bartholomew's Hospital, came in that year to act as Demonstrator of Anatomy in the University, and to carry on the class of microscopic anatomy. His first love was chemistry. Before his arrival in Edinburgh he had already discovered that the reducing substance in cerebro-spinal fluid was not sugar but some other substance.* Lister had arrived two years before him to visit Syme. When Turner arrived in Edinburgh we find Lister studying living anatomy in the frog's web—the shape and action of the muscle fibres of the arterioles, the pigment cells with their mysterious movements of granules—and the minute anatomy of the lacteals in the mesentery of the mouse. Presently we find Lister and Turner collaborating in a research on the anatomy of nerve fibres. They employed a carmine stain to differentiate the axis cylinders of nerve fibres from their sheaths; by this we see that anatomists were beginning to employ microscopic chemistry to help

* During the present year Sir William Turner conferred a boon on all students of medicine by publishing a list of his researches (from 1854-1910). The list contains the titles of 268 papers: (1) Human Anatomy and Physiology; (2) Comparative Anatomy and Geology; (3) Pathological Anatomy; (4) Anthropology; (5) General Addresses and Reviews; (6) In Memoriam Notices.

them in differentiating the elementary tissues of the body. Even at this early date Turner manifests a catholicity of taste in his research work. We find him investigating the results of obstruction of the thoracic duct, the condition produced by adhesion of the palate to the pharynx, the elimination of manganese from the body, cellular pathology, inflammatory changes in the peritoneum, and the microscopic anatomy and functions of the pancreas. The influence of Goodsir becomes apparent: Turner, too, falls a victim to the fauna of the beloved Firth. He becomes morphologist, and investigates the arch of the aorta and the nature of its aberrant branches. When the Darwinian movement broke out he took a leading part in the discussions of the time—the recent discoveries of fossil man, the characteristic features of the human brain, the laws which determine the shape of the human skull.

Goodsir had that power which marks the master—the power of attracting and influencing young, able men. Soon after Goodsir assumed the chair his demonstrator, Mr. C. H. Hallett, began to record systematically the deviations from the normal found during dissection of the human body. At that time such variations were regarded as meaningless, but Goodsir knew better. On no pupil was his influence stronger than on John Cleland, who became his demonstrator in 1857. He also worked at the fauna of the Firth, but his chief energies were given to furthering those problems at which Owen and Goodsir had worked concerning the morphological nature of the human skull and skeleton. In 1861 he went to assist Allen Thomson in Glasgow, in 1863 to Galway. The researches of James Bell Pettigrew,* who was a fellow demonstrator with Cleland, are marked by his own strong individuality. Beginning by an investigation of the nerve supply of the heart, he utilised his wonderful manipulative skill to unravel the complex musculature of the heart and other muscular viscera. Goodsir had no more devout pupil and demonstrator than John Chiene, Emeritus Professor of Surgery in this University. He turned his attention to surgical anatomy, and in one of his earliest papers he recognised and described accurately the condition now known as retro-peritoneal hernia. Sir William Mitchell Banks was another of the distinguished anatomical pupils of Goodsir.

* From 1862 to 1868 he was assistant to Sir William Flower in the Museum of the Royal College of Surgeons, England. He added many preparations of great value to the museum, and left behind him a skilled pupil in William Pearson, the present prosector to the college.

Change in the Anatomical Point of View.

By 1863 the anatomists in Scotland had become interested in the form of structures rather than in their function—they were searching for the basal plans on which the human body was constructed. The Darwinian movement again altered their point of view. They then began to search for the origin and evolution of structure. No doubt the neglect of function was due in some degree to the technical separation of anatomy from physiology which began with the 19th century, although in the University of Edinburgh they had been separated at a much earlier date (1726).

Anatomy in Scotland at the End of the 19th Century.

When we come to survey Scotland at the close of Sir John Struthers's life we see how amazingly the study of the human body has prospered. Edinburgh still held the pride of place, but Glasgow, Aberdeen, St. Andrews, and Dundee had also become centres of anatomical research. When in 1889, after 26 years of strenuous life, Sir John Struthers withdrew to Edinburgh to renew his early associations and his youth he had established in the University of Aberdeen a fully-equipped school of anatomy, and inspired a band of young anatomists. The most distinguished of these, Professor R. W. Reid, became his successor. Professor Wardrop Griffith was promoted to the Chair of Anatomy in Leeds, while in Sir John's later days Dr. Reginald Gladstone and the present lecturer had gained a footing in the anatomical schools of London. In 1877 Allen Thomson retired, and was succeeded in the chair at Glasgow by Professor John Cleland. By the end of the century it was very apparent that the inspiration and the methods of John Goodsir had prospered exceedingly in Glasgow, not only in Professor Cleland's own hands but also in those of his pupils, amongst whom were Professor Alexander Fraser of Dublin, Principal Mackay of Dundee, Dr. Bruce Young, Dr. James Hutton, Dr. James Gemmill, and Dr. Alex. Macphail.

Professor Bell Pettigrew held Reid's chair at St. Andrews, to which he was appointed in 1875. Seven years before going to St. Andrews he held the conservatorship of the museum of this college. He was a devout pupil of Goodsir's, as may be seen from the three volumes of his works, *Design in Nature*, published just after his death in 1908.

PORTRAIT OF SIR JOHN STRUTHERS (ÆT. 62).

Anatomy in Edinburgh during Sir William Turner's Professoriate.

In Edinburgh the University and extra-mural schools continued in their prosperity. When the founder of this lecture left Edinburgh in 1863 his old master, Dr. Peter D. Handyside, again took up anatomy and succeeded him at the School of Medicine, and continued to teach and research until his death in 1881, when, as we shall see, the anatomical staff of the extra-mural schools was recruited from the University. In 1867 John Goodsir died at the age of 53, and at the age of 35 William Turner succeeded him. The young professor took his place at once amongst the first anatomists of Europe, not by reason of the prestige of his chair, but by the right use of the great gifts Nature had bestowed on him. In the first year of his professoriate he rendered British anatomists an invaluable service by taking a leading part in founding and maintaining the *Journal of Anatomy and Physiology*. In the early numbers one can see how hard he must have worked and thought, how closely he followed the movements in continental schools, and how well he kept British anatomists informed of the most recent discoveries made abroad. By the end of the century he had become the father of the largest family of anatomists the world has ever seen. In 1874 his senior demonstrator, Morrison Watson, went to fill the Chair of Anatomy at Manchester, James Russell * succeeded to the senior demonstratorship, and room was thus made for the greatest of all Sir William Turner's pupils, Daniel John Cunningham—a man framed in Nature's most liberal mood. Amongst Cunningham's many gifts was that of exposition, which, when he had gone to Dublin in 1882, he employed most happily in systematising the teaching and traditions of the Edinburgh School of Anatomy. Professor Cossar Ewart was a fellow demonstrator with Cunningham; in 1876 Alfred H. Young went to assist and to succeed Professor Morrison Watson; Johnson Symington, after demonstrating at the University (1877-1880), became the first lecturer of anatomy at Minto House,† and continued to teach and research in the extra-mural school until he went to Belfast in 1894. I will content myself by merely naming the succession of pupils and demonstrators who took up the study of anatomy during the last two decades of the century. Arthur

* Sir James A. Russell, Inspector of Anatomy for Scotland.

† Minto House. Note by Dr. Whitaker.

Thomson (to Oxford, 1885); David Hepburn (to Cardiff, 1903); A. M. Paterson (to Dundee, 1888, to Liverpool, 1894); Arthur Robinson (to Manchester, 1885); James T. Wilson (to Sydney, 1885); Robert Howden (to Newcastle, 1889); Th. H. Bryce (to Queen Margaret's College, Glasgow, 1890); A. W. Hughes (to Cardiff, 1893); James Musgrove (to St. Andrews, 1897); Edward Fawcett (to Bristol, 1894); R. J. A. Berry (to Melbourne, 1906); David Waterston (to King's College, London, 1909); and Professor Charnock Bradley. Many of these taught in the extra-mural school before leaving Edinburgh. C. R. Whitaker, the present lecturer in the School of Medicine, a pupil of the extra-mural school, commenced to teach in 1894. Amongst the extra-mural lecturers I must not omit the names of three men who, although not professional anatomists, yet contributed to the literature of anatomy—Mr. C. W. Cathcart,* Professor F. M. Caird, and Dr. Macdonald Brown.

The Nature of Anatomical Research in the Later Decades of the 19th Century.

In the last three decades of the 19th century we see the straggling band of Scottish anatomists becoming a disciplined army, and we will now direct our attention to the manner in which they were seeking to extend our knowledge of the human body. Although Allen Thomson introduced at an early date the study of human development, yet embryological research never really throve in Scotland; we took only a small share in securing the harvest of knowledge available at the end of the 19th century. The present distinguished occupant of the Chair of Anatomy in this University was the only one of the younger anatomists who devoted himself to research on the embryo; the valuable inquiries of Dr. John Beard were carried out in Edinburgh, and those of Professor Charnock Bradley belong to a later date. It was not until the next century opened that the German methods of investigation and of reconstruction were introduced, when we see them being applied with excellent effect by Dr. Alex. Low of Aberdeen. Amongst his many subjects of research Professor Cleland included the conditions which arise from disturbances during the development of the embryo, and his pupil, Dr. James Gemmill, is the only one in Scotland who took up the experimental study of the embryo; yet on the Continent and in America

* Mr. Cathcart succeeded Dr. Handyside in 1881.

this method of research has been used with excellent results for thirty years. It was *during* this period that Dr. Ballantyne produced his standard work on the deformities which arise in the human body during development; at a later date Professor Bryce and Dr. Teacher described one of the earliest stages yet seen in the development of the human embryo.

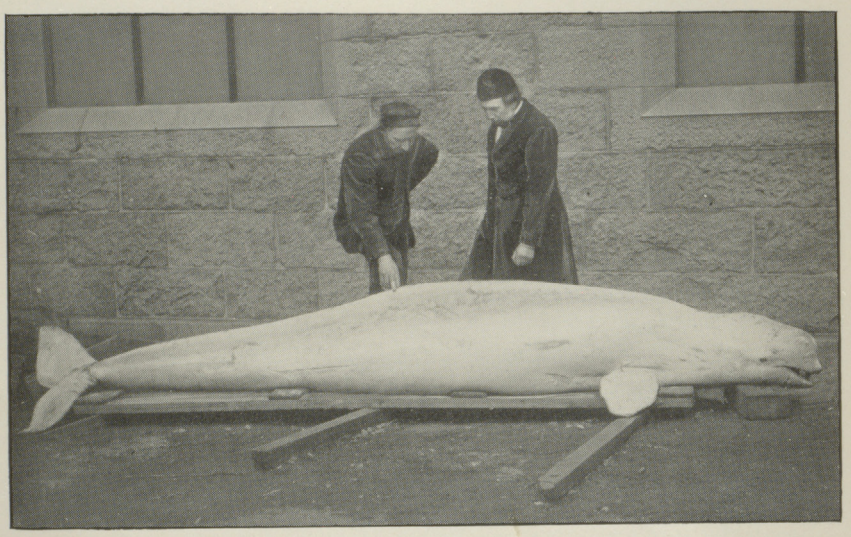
It was in the time of Sir John Struthers that we became acquainted with the miscroscopical structure of the human body, but the share taken by the Scottish anatomists in this work was a minor one. This is the more strange when we remember that Goodsir and Hughes Bennett were pioneers in this work. In his early research work on the pancreas, nerve fibres, tumours, and especially during his investigation of the placenta, we see that Turner was an expert microscopist. The modern method of preparing tissues for microscopic examination, of cutting sections and staining them, was employed in Scotland at an early date. In some directions we were pioneers. In 1869 Mr. A. B. Stirling, museum assistant under Goodsir and Turner, invented an instrument for cutting tissues into fine sections for microscopical examinations; in 1882 Mr. Cathcart introduced his ether freezing section cutter; and in 1883 Dr. Caldwell, an Edinburgh graduate, invented an automatic microtome (Cambridge Rocker). During the later decades of the century students were taught how to examine the tissue of the body with the microscope both in the anatomical and in the physiological departments of all the Scottish universities, and yet no expert of the first rank was produced in this department of research. The early work of my old teacher, Professor William Stirling, shows that if other forms of research had not called him he could have taken that rank.

The Influence of Knox, Goodsir, and Darwin.

The direction which research took amongst the anatomists of Scotland during the last four decades of the 19th century was determined by the ideals and traditions of Knox and of Goodsir, moulded and tempered by the discoveries of Darwin. Anatomists set out, as Knox and Goodsir had done, to discover that larger kingdom of which man was a part. They followed Darwin in seeking to trace his past history by the aid of comparative anatomy; they realised that the only sure foundation for human anatomy was a wide study of all forms of life. Let me take two typical examples from the work of Sir William Turner. In 1872

doubts were again raised as to the structure of the human placenta. He first verified, as John Reid and Goodsir had done, that the Hunterian discovery was right; in the previous year he had examined the placenta of a whale (Orca gladiator). During the subsequent 18 years he availed himself of every opportunity to study the placenta in all classes of mammals. He found, as he expected from Darwin's teaching, that various stages in the evolution of the placenta were still to be seen in modern mammals, and that the human placenta represented only one of the types which had been evolved. Later Hubrecht discovered the trophoblast, and Selenka showed that, as far as concerns the placenta, man and anthropoid were the same. During that period he was also studying the brain in the same manner. He—as was the case with all the anatomists in Scotland—developed a passion for observing and recording every fact which could directly or indirectly throw light on the laws which determine animal form. Now of all the experiments which Nature ever made in adaptation and in change of form, none are more wonderful than the examples to be seen in the anatomy of whales—land mammals which have come to live a fish-like life. At the beginning of the century Geoffroy St. Hilaire found the rudiments of teeth under the whale-bone plates; Knox made whales a subject of study; Goodsir had his eye on them; and, after *The Origin of Species* was published, we find first Professor Turner and then Professor Struthers take up the investigation of their structure in earnest. By 1889 Professor Struthers had made dissections of 11 specimens, representing most of the species which become stranded from time to time on the shores of Scotland.* Nowhere will you find more accurate records and finished studies of special adaptations and of vestigial structures than are to be seen in publications of Sir John Struthers. His investigations were carried out at those times

* I was greatly elated when Sir John Struthers asked me to stay at college with him on a Saturday afternoon during the winter of 1885-86, to assist in dissecting parts of the Tay whale. He was then examining the genital organs. I must have been a chatter-box; at least he suddenly stopped me with the exclamation that I had raised over fifty subjects for discussion in less than fifty minutes, and that I must really learn to think consecutively. To my regret I was never again allowed to assist him. My friend, the late Dr. Charles Angus, became his favourite assistant. He was fortunate, as is so often the case with anatomists in Scotland, in having a most skilled and sagacious anatomical assistant in Mr. Robert Gibb, a genuine working-man naturalist, who became assistant in the anatomical department in 1872. He retained his post under Professor Reid until he died, on 23rd May 1911, an old man, and regretted by generations of Aberdeen medical students.



Sir John Struthers and his Anatomical Assistant, Robert Gibb, Surveying the Body of the White Whale (1886).

when other men take their leisure, and under circumstances which would have turned most men away. When, in 1876, the *Challenger* returned with her spoils, collected in all parts of the world, the task of investigating the structures of the mammals fell on Sir William Turner and his pupils. It was while investigating the anatomy of the marsupials that Professor Cunningham came to formulate his theory of the primary arrangement of the musculature of the hand and foot. Thus we see that in the later decades of the 19th century, while microscopic anatomy and embryology were mainly engaging the attention of the continental anatomists, in Scotland their professional brethren were seeking to lay our knowledge of the human body on the broad basis of comparative anatomy.

Research on the Origin of Man.

From 1860 onwards the anatomists of Scotland came more and more under the influence of the evolutionary movement. Darwin's *Origin of Species* (1859); his *Descent of Man* (1871); Huxley's *Man's Place in Nature* (1863); and Lyell's *Antiquity of Man* (1863) led them to study the human body in another way. Variations in the form and arrangements of parts so frequently found in man's body were studied and recorded, with a view to throwing light on man's origin. With the same object in view the anatomy of the anthropoid apes became a favourite and profitable subject of investigation. Although no remains of very ancient man—such as were found from time to time in Germany, Belgium, France, and Java—were found in Scotland, nor do we expect that fossil remains of man will ever be found within her borders, yet such discoveries were watched with interest and examined critically in Scotland. Knox had studied the races of mankind, but his brilliant speculations were ill calculated to form the basis of further research, and died with him. An Edinburgh graduate, Dr. James Cowles Prichard, was the leading anthropologist in the first part of the 19th century. When he died in 1848 he left a monument of splendid work behind him, but no school of disciples. In 1852 Dr. John Beddoe, who died in 1911, arrived in Edinburgh from University College, London, became a medical graduate of this University, and set out to make an anthropological survey of the Scottish people—the first ever made. Soon after 1860 the French School of Anthropologists, of Broca, Quatrefages, Hamy, and Topinard, systematised the methods of anthropology; towards the end of the century their methods were being introduced.

Throughout this period (1860-1899) craniology was a subject of study and research at Glasgow, Aberdeen, and Edinburgh; collections of crania and skeletons of all the races of mankind, both ancient and modern, were being formed in connection with the anatomical departments of the universities. With the assistance of his students Sir William Turner made the collection in the University Museum one of the best in the world. Towards the end of the century his memoirs on the osteology of the races of mankind began to appear, but the one which must interest us most is that on the *Craniology of the People of Scotland*, which he issued in 1903. Is it not a strange fact that Scotland should owe the first contribution to her physical anthropology to Beddoe and Turner, two Englishmen? Professor Struthers, and especially his successor at Aberdeen, Professor Reid, realised the need to preserve and record those remains of ancient man which are occasionally exposed by the plough or spade; these old bones are documents from which the history of races in Scotland may yet be written. Professor Bryce has shown how such documents may be utilised. By the end of the 19th century Scottish anatomists had begun to realise the necessity of making an anthropological survey of their own people, of seeking to analyse the various racial ingredients out of which the modern Scot has been evolved. By 1895 Professor Reid of Aberdeen had equipped and placed in working order an anthropological laboratory in his university, and with the assistance of the members of the Buchan Field Club set out to survey the people in the north-east of Scotland.

Research in Applied Anatomy.

It must not be supposed that the practical anatomy of the human body was neglected in Scotland during the last 40 years of the 19th century. In the main the improvement in our knowledge made then relates to observations concerning the exact shape and relationship of parts. One of the most outstanding contributions of this period is *The Topographical Anatomy of the Child*, which Professor Symington published in 1887, when lecturer here at the School of Medicine. The anatomy of the child had been neglected. The method he used was that introduced by Pirogoff in 1856 and popularised by Braune of Leipzig ten years later, namely, of studying the exact relationship of parts by making accurate sections of the frozen body. During the same period Dr. Berry Hart employed this method in producing a

standard *Atlas of the Female Pelvis*. Indeed much of the best practical work of this period was done by men who were not professional anatomists. Before he left Edinburgh in 1877 Dr. Matthews Duncan had made additions to our knowledge of the human pelvis of the most important kind. Dr. Robert Foulis's investigations of the human ovary deserve more than a passing mention. The researches of the late Dr. Alexander Bruce on the anatomy of the spinal cord and of the mid-brain are sufficient to place him in the first rank of the Scottish anatomists of his time. The studies which Professor Ogston of Aberdeen made on the growth of bone and cartilage in 1875 and 1877 have not received the attention which they merit. To pathologists such as Professor D. J. Hamilton and Professor W. A. Welsh we owe studies in the anatomy of the corpus callosum and on parathyroid bodies. In the last two decades of the century we see the method introduced by Professor His of Leipzig, of studying the viscera after injecting the body with a "hardening" solution, being employed in Scotland; the use of formalin for this purpose became very general after 1895. The introduction of this method led to a redescription of the viscera. About the same date (1895) it became possible, thanks to the discovery of Röntgen, to illuminate the living human body and thus study its anatomy. The revolution which this method is destined to effect lies in the 20th century, but we note that Mr. Harold J. Stiles had realised its value and applied this means to anatomy by 1898.

A survey of the work done in anatomy during the lifetime of Sir John Struthers shows the change which had affected the outlook of our anatomists. One can see that the study of form became more and more prominent, while the study of function came to have quite a secondary place in their consideration.

Other Aspects of Sir John Struthers's Career.

Now I have come to the end of my task, and it must be very apparent to all who knew Sir John Struthers that in limiting my survey to the research work—the produce of an anatomist's leisure time—I have done his memory less than justice. From the day he began to teach anatomy under the ægis of this college in 1845 until the day of his death in 1899 he fought continuously and courageously for freedom to teach and to research, for the progress of research, of true knowledge and of medicine, and of medical education, for liberty of thought, and for the rights of

institutions and of women; and yet all these endeavours of a many-sided career I have passed unnoted. A bare account of his researches would have constituted a worthy subject for this lecture, but that is the last theme Sir John Struthers would have liked me to adopt. I have sought to follow him as a student of history, and I am not worthy to be his pupil unless I have his courage to speak out freely and fully what I believe to be the true lessons which I have learned from this study.

Suggestions Drawn from a Study of the History of Anatomy in Scotland.

I have been surveying the history of anatomy in Scotland with a purpose, one which I can best introduce to you by relating how it came to take hold of me. I owe to Sir John Struthers the impulse which made me a student of anatomy. Under his inspiration, during 1884, 1885, and 1886, I became an enthusiastic follower of Owen, Huxley, and Darwin; the origin of man became with me a more important matter than the healing of his body. In 1895, after spending seven years in the kind of investigations which was most likely to throw light on man's origin, I came to teach anatomy at the London Hospital and continue my researches. It was then, as my students passed into the wards, that I came to doubt whether my teaching and my research were really the best possible to adapt medical students for their life's work. They had to deal with cases of appendicitis; I could not explain to them why the appendix was present in the body, nor why it was placed in the loin and shaped as a narrow blind tube. They saw cases of disease of the antrum of the mastoid, and yet, although the shape and position of this small cavity could be described with accuracy, no hint as to why it was there and what function it served could be offered. They had to examine patients with the accessory chambers of the nose full of pus, but why such large air chambers should exist in man could not be explained. They daily saw children with enlarged tonsils or with adenoids, but we could not tell them why these structures were placed in the throat, nor give an explanation of their anatomy. They saw the gall-bladder opened for the removal of gall-stones, but I knew nothing of its functions nor of its anatomical meaning. They saw the prostate being removed for disease, but the reason of its existence in the human body was not thought of. Even with such vital and well-known organs as the heart and lungs we

could offer our students no satisfactory explanation of their shape, of the manner of their fixation, of the arrangement of their musculature, nor of the peculiarities in their nerve and blood supply. When, however, I became acquainted with the works of the anatomists who led the way at the end of the 18th century —of the Hunters, the Monroes, and Bells—I found their efforts were directed to answer such questions as I have just mentioned; they studied anatomy to understand the meaning and function of the parts of the body. At the beginning of the 20th century we were studying anatomy to describe form. It was to see how this revolution had occurred in our outlook that I made a study of the history of anatomy during the 19th century. We see that the anatomy of the Hunters, Monroes, and Bells was not really killed by the separation of the teaching of anatomy from physiology. It was those gifted non-medical children of the French Revolution —Cuvier, Geoffroy St. Hilaire, and Lamarck—who killed the study of function. We see the movement started by them, elaborated by Owen, and transformed by Darwin become domiciled in Scotland for the greater part of the century. That movement has been prolific in its results; it has laid our knowledge of the human body on the sure foundation of comparative anatomy; but now, it seems to me, has come the time to look to the future. A knife and forceps, with close observation and hard thinking, will accomplish much, but to face the modern problems of anatomy with such an outfit is to use a muzzle-loader where a repeating rifle is available. In recent times we have seen that the problems of human anatomy are yielding most readily to those who use the experimental method. By stimulating the cortex and by causing artificial degeneration of nerve tracts the anatomy of the brain has been gradually discovered. Our modern knowledge of the anatomy of the heart and of the visceral nerves of the body are largely based on the experimental work of Gaskell. I need not multiply examples. The modern anatomist, if he is to help in solving the problems of the human body, must avail himself of the methods of the professed physiologist; he must study the living as well as the dead body; he has to seek assistance in embryology, in comparative anatomy, and in those experiments of which, unfortunately, disease makes man so often the subject. We have come to the time when we anatomists must reconsider our methods and our aim. At least that is the inference I draw from a study of the history of our subject in Scotland during last century. In short, we have to study function, which is the key to form.