LECTURE I

VESALIUS: HIS FORERUNNERS AND FOLLOWERS

I MAKE no apology for having chosen as the subject of the course of Lectures which you have honoured me by inviting me to deliver, 'The History of Physiology.' We are, all of us, even in this farthest West, even in this closing year of the nineteenth century, Children of our Fathers. What we are is in part only of our own making, the greater part of ourselves has come down to us from the past. What we know and what we think is not a new fountain gushing fresh from the barren rock of the unknown at the stroke of the rod of our own intellect, it is a stream which flows by us and through us, fed by the far-off rivulets of long ago. As what we think and say to-day will mingle with and shape the thoughts of men in the years to come, so in the opinions and views which we are proud to hold to-day, we may, by looking back, trace the influence of the thoughts of those who have gone before. Tracking out how new thoughts are linked to old ones, seeing how an error cast into the stream of knowledge leaves a streak lasting through many changes of the ways of man, noting the struggles through which a truth now rising to the surface, now seemingly lost in the depths, eventually swims triumphant on the flood we may perhaps the better learn to appraise our present knowledge, and the more rightly judge which of the thoughts of to-day is on the direct line of progress, carrying the truth of yesterday on to that of to-morrow, and which is a mere fragment of the hour, floating conspicuous on the surface now but destined soon to sink, and later to be wholly forgot.

Nor need I, I trust, make any apology for having, though invited to speak to medical hearers, chosen not the history of medicine but the history of physiology. The whole story of the rise and growth of the art of healing is too vast to be gathered into one set of lectures, too varied to be treated of by one man alone. I have chosen that part of the whole story with which alone I am competent to deal; and I venture to think that, without appearing to exalt unduly my own studies, I may go as far as to say that a knowledge of the laws which govern the

phenomena of all living things is so essentially the basis of all attempts to succour, or to watch over the welfare of, one set of beings that the history of physiology cannot be regarded in any other light than as the heart or kernel of the history of medicine.

I do not propose to begin at the beginning of things. I will leave on one side, for the present at least, the details of the knowledge of the phenomena of life possessed by those whom we speak of as 'the ancients.' I will ask you to let me start with the middle of the sixteenth century, and indeed with the particular year 1543.

Those were stirring times, times of wars and rumours of wars. The brilliant career of Charles V was drawing towards its close; in that very year he was in the midst of his fourth, his last and short war with his rival Francis I of France. Venice had still all the signs of outward splendour, but within the rift in the lute was rapidly widening. The Medici were once more established at Florence, and the burly Henry VIII was ruling over England. Some twenty years before Cortez had conquered Mexico, some ten years before Pizarro had laid hold first of Peru and then of Chili; and Europe in the East was enjoying the spoils of the West.

The times were times of strong under-currents of thought. The Reformation was abroad. Luther was living his last years —he died in 1546, the year after the Council of Trent—and Calvin was strong at Geneva; but the order of the Jesuits was already a year old, and the Inquisition held Spain in its grip. It was the heyday of Art. Though Raphael had been dead for three and twenty years, Michael Angelo had nearly as many yet to live, and Titian was in his prime. The new learning was everywhere working like leaven; the old Universities were expanding and new ones were springing up everywhere, the worth of the Greek tongue was preached by the learned; and the great exponent of the oldest of sciences, that of the heavens, Nicolas Copernicus, closed his eyes in this very year. Moreover learning was being spread as well as made; printing had seen its hundredth birthday and the presses of Venice and other cities were pouring forth the means of knowledge. The night of the middle ages had passed away in the dawn of modern times.

In this year 1543 the printing-press of J. Oporinus (or Herbst) in Basel gave to the world in a folio volume the *Fabrica Humani Corporis*, the Structure of the Human Body, by Andreas Vesalius. This marked an epoch in the history of Anatomy, and so of Physiology and of Medicine. Who was Andreas Vesalius, and why did his book mark an epoch?

Let me briefly answer the latter question first. In the times of the Greeks mankind had made a fair start in the quest of natural knowledge, both of things not alive and of things living; the search had been carried on into the second century of the Christian Era when Galen expounded the structure and the use of the parts of the body of man. As Galen passed away inquiry, that is to say inquiry into natural knowledge, stood still. For a thousand years or more the great Christian Church was fulfilling its high mission by the aid of authority; but authority, as with the growth of the Church it became more and more potent as an instrument of good, became at the same time more and more potent as a steriliser of original research in natural knowledge.

The Church held the gates of learning, and they who entered were bidden to tread her path and hers alone. Her methods became the methods of all scholars. Under her guidance the written word took the place of the made world; the pursuit of truth ceased to be the looking into the phenomena of nature and the seeking for the reason why; it narrowed itself to asking what the teachers taught. The method which had proved triumphant in the search after things spiritual was taken to be the method in all inquiry, and biologic inquiry was no exception. As spiritual truths were learned by the study of the revealed word, so anatomical and medical truths were to be sought for, not by looking directly into the body of man, not by observing and thinking over the phenomena of disease, but by studying what had been revealed in the writings of Hippocrates and Galen. As the Holy Scriptures were the Bible for all men, so the works of the Greek and Latin writers became the bible for the anatomist and the doctor. Truth and science came to mean simply that which was written, and inquiry became mere interpretation.

The 'new birth' of the fifteenth and sixteenth centuries was in essence a revolt against authority as the guide in knowledge; and the work of Andreas Vesalius of which I am speaking marks an epoch, since by it the idol of authority in anatomical science was shattered to pieces never to be put together again. Vesalius described the structure of the human body such as he found it to be by actual examination, by appealing to dissection, by looking at things as they are. He dared not only to shew how often Galen was wrong, but to insist that when Galen was right he was to be followed, not because he had said it, but because what he said was in accordance with what anyone who took the pains to inquire could assure himself to be the real state of things.

Vesalius like other great men had his forerunners. Long before him at the close of the thirteenth and beginning of the fourteenth century Mundinus, Mondino (Raimondo de' Luzzi), one of the teachers of the early days of the then great University of Bologna, had dared to turn his eyes from the pages of Galen to that of nature, and to learn for himself by actual dissection how the body of man was built up. He learnt enough to write a book of his own, the *Anatomia Mundini*, which after him became a text-book in the schools, though used perhaps more as an introduction or help to Galen than in any other way. But Mundinus did not go far. He like other anatomists, like indeed Vesalius himself, had to struggle against not only the authority but the direct hand of the Church. She taught the sacredness of the human corpse, and was ready to punish as a sacrilege the use of the anatomist's scalpel; and what Mundinus did was done in the face of her powerful opposition. For this reason apparently Mundinus had no disciples carrying on his work; all that remained of him was his book, and he became little more than a smaller and a later Galen.

Two centuries later, at the very beginning of the sixteenth century, the power of the Church in its struggle against the new light was lessening, and Jacobus Berengarius, often called Carpi, from the place of his birth, a town in the state of Modena, followed in Mundinus' steps with greater effect. He asserts that he dissected no less than a hundred corpses, and

his teaching was undoubtedly to a large extent based on his own direct observations.

He too however had his struggles with the Church; he was driven to desert Bologna where he had long taught, and to live in retirement if not in exile at Ferrara. Nor did he succeed in wholly reforming anatomical science, or in placing anatomical inquiry on its only sound basis. For when he had passed away the position of Master in Anatomical Science was taken by a man of a different stamp, by Jacques Du Bois, Jacobus Sylvius, a native of Amiens, who in 1531 began to teach anatomy at Paris, and in 1550 succeeded Vidus Vidius in the Chair of Medicine at the recently established College of France.

Sylvius, though in spite of his own attitude he added to our knowledge of anatomy (we daily in the present time name him when we speak of the fissure of Sylvius), was an uncompromising Galenist. He trusted Galen more than he did his own eyes, and in everything taught or rather preached Galen. Instruction in anatomy was to him reading a chapter of Galen, and though he did make use of dissections, these were used as mere concrete illustrations to render easy the comprehension of what he was teaching, not as tests by which the truth of what he was stating might be tried.

Sylvius, as we shall see, was Vesalius' master, as indeed the master of most anatomists of the age. His influence was at the time of which we are speaking predominant; with his help the past efforts of Mundinus and of Carpi were brushed aside, and Galen and authority reigned supreme in anatomical teaching and thought. He was however the last of his school; his teaching was swept away by the new learning embodied in the *Fabrica Humani Corporis* of Andreas Vesalius.

Who then was this Andreas Vesalius?

He was born at Brussels at midnight as the last day of 1514 was passing into the first of 1515. His family, which had dwelt for several generations at Nymwegen and which originally bore the name of Witing, had produced many doctors and learned men, and his father was apothecary to Charles V. His mother, to judge by her maiden name, Isabella Crabbe, was probably of English extraction.

The young Vesalius (or Wesalius, for so it was sometimes spelt) was sent to school at Louvain and afterwards entered the University there, which then as later was of great renown. Though he diligently pursued the ordinary classical and rhetorical studies of the place, the bent of his mind early shewed itself; while yet a boy he began to dissect such animals as he could lay his hands on. Such a boy could not do otherwise than study medicine, and in 1533, a lad of seventeen or eighteen, he went to Paris to sit at the feet of Sylvius, then rising into fame.

The ardent young Belgian was however no docile hearer, receiving open-mouthed whatever fell from the master. Sylvius' teaching was as I have said in the main the reading in public of Galen. From time to time however the body of a dog or at rarer intervals the corpse of some patient was brought into the lecture room, and barber servants dissected in a rough, clumsy way and exposed to the view of the student the structures which the learned doctor, who himself disdained such menial, loathsome work, bid them shew. This did not satisfy Vesalius. At the third dissection at which he was present he, already well versed in the anatomy of the dog, irritated beyond control at the rude handling of the ignorant barbers, pushing them on one side, completed the dissection in the way he knew it ought to be done.

"My study of anatomy," says he, "would never have succeeded had I when working at medicine at Paris been willing "that the viscera should be merely shewn to me and to my "fellow-students at one or another public dissection by wholly "unskilled barbers, and that in the most superficial way. I "had to put my own hand to the business."

Besides listening to Sylvius, he was a pupil of Johannes Guinterius (Günther), a Swiss from Andernach, who also was teaching anatomy and surgery at Paris at the time, and with whom his relations seem to have been closer than with Sylvius.

Neither Sylvius, however, nor Guinterius, nor any one at the time was able to supply Vesalius with that for which he was obviously longing, the opportunity of dissecting thoroughly the human body. Complete dissection was then well-nigh impossible, the most that could be gained was the hurried

examination of some parts of the body of a patient who had succumbed to disease. One part of the human body, the foundation of all other parts, the skeleton, could however be freely used for study. In those rude times burial was rough and incomplete, and in the cemeteries bones lay scattered about uncovered. In the burial-ground attached to the church of the Innocents at Paris Vesalius spent many hours, studying the bones; and he also tells us how in another burial-ground, on what is now 'Les Buttes Chaumont,' he and a fellow-student nearly left their own bones, being on one occasion attacked and in great risk of being devoured by savage, hungry dogs who too had come there in search of bones. By such a rough, perilous study Vesalius laid the foundation of his great work, a full and exact knowledge of the human skeleton. He tells us how he and a fellow-student were wont to try their knowledge by a test which has been often used since, the recognition of the individual bones by touch alone, with the eyes shut.

After three years the wars drove him back from Paris to Louvain, where he continued to pursue his anatomical studies with unflagging zeal. Here as at Paris he was driven to use strange means to gain the material for his studies. Walking one day with a friend in the outskirts of the city and coming to the public gibbet, where "to the great convenience of the "studious, the bodies of those condemned to death were ex- "posed to public view," they came upon a corpse "which had "proved such a sweet morsel to the birds that they had most "thoroughly cleaned it, leaving only the bones and ligaments." With his friend's help he climbed up the gallows and attempted to carry off the skeleton, but in the hurry of such a theft in open daylight he only succeeded in getting part of it; accordingly that evening he got himself shut out of the city gates, secured in the quiet of night the rest of the skeleton, and returning home by a roundabout way and re-entering the city by a different gate, safely carried it in.

In 1537, after a year's stay at Louvain where, in the February of that year, he put forth his first juvenile effort, a translation of the ninth book of Rhazes, he migrated to Venice, the enlightened if despotic government of which was in all possible ways fostering the arts and sciences, and striving to

develop in the dependent city of Padua a University which should worthily push on the new learning. It may be worth while to note, as an instance of how in the web of man's history threads of unlike kind are made to cross, that among the monks who had charge of the Hospital at Venice, at which Vesalius pursued his medical studies, was one who bore the name of Ignatius Loyola. We may well imagine that these two young men crossed each other's path in the hospital wards or grounds, perhaps even conversed with one another. One was gathering in a rich harvest of exact knowledge which six years later he was to embody and give to the world in a great book, the beginning of modern biologic science. The other was busy with a scheme for the spiritual welfare of mankind which six years later took shape as the Order of the Jesuits. The one with his eyes fixed on man's body brought forth a work, the fruits of which have profoundly influenced and are still profoundly influencing men's minds. The other, with his eyes fixed only on truth and goodness, began that which after him became the incarnation of Authority, an engine powerful it is true for good, but often used for the support of lies and for the maintenance of evil. No two things have fought and are fighting each other more bitterly than the things which have sprung from the two works of the two young men who crossed each other's path at Venice in the year of our Lord 1537.

The brilliant talents of the young Belgian at once attracted the notice of the far-sighted rulers of Venice. He was in December of that same year, 1537, made Doctor of Medicine in their University of Padua, was immediately entrusted with the duty of conducting public dissections, and either then or very shortly afterwards, though he was but a lad of some one or two and twenty summers, was placed in a Chair of Surgery with care of Anatomy.

He at once began to teach anatomy in his own new way. Not to unskilled ignorant barbers would he entrust the task of laying bare before the students the secrets of the human frame; his own hand, and his own hand alone, was cunning enough to track out the pattern of structures which day by day were becoming more and more clear to him. Following venerated customs he began his academic labours by 'reading' Galen, as

others had done before him, using his dissections to illustrate what Galen had said. But time after time the body on the table said plainly something different from that which Galen had written.

He tried to do what others had done before him, he tried to believe Galen rather than his own eyes, but his eyes were too strong for him; and in the end he cast Galen and his writings to the winds and taught only what he himself had seen and what he could make his students see too.

Thus he brought into anatomy the new spirit of the time, and the men of the time, the young men of the time answered to the new voice. Students flocked to his lectures, his hearers amounted it is said to some five hundred, and an enlightened Senate recognized his worth by repeatedly raising his emoluments.

Such a mode of teaching laid a strain on the getting of the material for teaching. Vesalius was unwearied in his search for subjects to dissect. He begged all the doctors to allow him to examine the bodies of their fatal cases. He ingratiated himself with the judges, so that when a criminal was condemned to death they gave directions that the sentence should be carried out at such a time, and the execution should be conducted now in this manner, now in that as might best meet the needs of Vesalius' public dissections. Nor did he shrink apparently from robbing the grave, for he relates how, learning of the death and hurried burial of the concubine of a monk, he got possession of the body, and proceeded at once to remove the whole of the skin in order that the peccant holy man, who had got wind of the matter, might be unable to recognize his lost love. And he made dissections in Bologna as well as Padua.

Far away from the papal throne, in distant Spain, the Church was all-powerful, and there desecration of the corpse with the knife was well-nigh impossible. In Belgium too and in France opportunities for dissection were rare. But here, in Venice, nearer the papal seat, the Church's hand was less heavy. The high-spirited citizens of the Republic were resisting as we know in many ways the Pope's demands; and under the protection of the Senate, Vesalius had opportunities for the advance of knowledge which he could not have enjoyed elsewhere.

Five years he thus spent in untiring labours at Padua. Five years he wrought, not weaving a web of fancied thought, but patiently disentangling the pattern of the texture of the human body, trusting to the words of no master, admitting nothing but that which he himself had seen; and at the end of the five years, in 1542, while he was as yet not 28 years of age, he was able to write the dedication to Charles V of a folio work, entitled the 'Structure of the Human Body,' adorned with many plates and woodcuts, which appeared at Basel in the following year, 1543. He had in 1538 published, under the sanction of the Senate of Venice, Anatomical Tables, and in the same or succeeding year had brought forth an edition of Guinterius, a treatise on blood-letting, and an edition of Galen. There is a legend that the pictures in the great work were by the hand of Titian, but there seems no doubt that they, like the Tables, were done by one John Stephen Calcar, a countryman of Vesalius.

This book is the beginning not only of modern anatomy but of modern physiology.

We cannot it is true point to any great physiological discovery as Vesalius' own special handiwork, but in a sense he was the author of discoveries which were made after him. He set before himself a great task, that of placing the study of human anatomy on a sound basis, on the basis of direct, patient, exact observation. And he accomplished it. Galen had attempted the same thing before him; but the times were not then ripe for such a step. Authority laid its heavy hand on inquiry, and Galen's teaching instead of being an example and an encouragement for further research, was, as we have said, made into a bible, and interpretation was substituted for investigation. Vesalius, inspired by the spirit of the new learning, did his work in such a way as to impress upon his age the value not only of the results at which he arrived, but also and even more so, of the method by which he had gained them. He taught in such a way that his disciples, even when they thought him greater than Galen, never made a second Galen of him; they recognized that they were most truly following his teaching as a whole when they appealed to observation to shew that in this or that particular point his teaching was