A portrait of Vesalius. This is possibly an authentic likeness as it dates from Vesalius' lifetime.
N. Wright.

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In the section dealing with pre-Vesalian anatomy, I shall limit myself as much as possible to those aspects of anatomy which have the greatest bearing on Vesalius' work. As the title of the essay includes "Re-birth of Anatomy," I will attempt to outline the course of Vesalius' ideas, how they were received, and indicate how they would influence the thinking of future anatomists.

VESALIUS AND THE RE-BIRTH OF ANATOMY.

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Preamble.

This essay falls naturally into three parts: pre-Vesalian anatomy, the life and work of Vesalius, and the impact of his ideas on his contemporaries and on anatomists after him. In the section dealing with pre-Vesalian anatomy I shall limit myself as much as possible to those aspects of anatomy which have the greatest bearing on Vesalius' work. As the title of the essay includes "Re-birth of Anatomy" I will attempt to outline the spread of Vesalius' ideas, how they were received, and indicate how they moulded the thinking of future generations.

PART I

Pre-Vesalian Anatomy.

1. Anatomy before Galen.

The basis of human anatomy is, of course, dissection of the human body. The possibility of progress in the study of anatomy is dependent on the cultural level of society and also on the degree of religious sophistication attained by that society. Only in highly developed cultures has
anatomy become permissible. Almaeon of Crotona (500 B.C.) probably dissected goats. Plato, from his writings in the Timaeus, obviously had no anatomical knowledge. His thought was always of influence, particularly in the Middle Ages until the Aristotelian revolution. The early Hippocratic writings, especially on fractures and dislocations, betray a slight anatomical knowledge, possibly picked up from practical surgery. Diocles practised in Athens around the middle of the fourth pre-Christian century. Though his writings have disappeared it seems possible that he carried out human dissection privately. He regarded the heart as principal organ and seat of the intelligence; a view held by Aristotle. Aristotle lived from 384 - 322 B.C. and though he never carried out human dissection he is of considerable importance because of the theories he put forward. One of his principles was that nature never does anything in vain and hence each part of the body has a function which is demonstrated by its activities. This view fitted very well with Christianity and the idea of a creator and this led in time to speculation about ultimate purposes rather than actual structures. Aristotle projected from lower animals to man. He thought that the action of the brain was to cool the heart; that the heart had three ventricles and that it varied in size according to the size of the individual. Theophrastus of Ereseus (370 - 287 B.C.) was Aristotle's
successor at the school in Athens; only a few fragments of his anatomical studies survive but it is known that he differed from Aristotle in thinking that the brain was the seat of the intelligence.

2. The Alexandrian School.

The culmination of the first period of anatomical investigation was in Alexandria during the third century B.C. This centre, founded in 322 under the Ptolemaic dynasty, achieved a religious and scientific sophistication sufficient to allow intensive study of the human anatomy.

Herophilus of Chalcedon, (approx. 300 B.C.) was stated by Galen to have been the first person to carry out human dissection publicly. None of his works is extant. He seems to have grasped the fact that the brain is the central nervous system, that some nerves are motor and some sensory, that veins are different from arteries and that both contain blood.

Erasistratus followed Herophilus, but as his contributions were more physiological than anatomical, we will not deal with his views. After this first generation of anatomists, interest in the subject flagged and dissection petered out around 150 B.C.
3. The Roman Empire.

Under the Roman Republic and Empire dissection of the human being was against the law. Celsus (B.C. 30) was the only imperial Roman to write in Latin. His 'De Re Medica' was not rediscovered until the Renaissance, and though it mainly consists of a paraphrase of the Hippocratic collection, it had considerable influence. The other writers during the Roman period wrote in Greek.

Rufus (A.D. 50) was taught in Alexandria. His work "On the Naming of the Parts of the Body" is the first known attempt at developing an anatomical nomenclature. In his anatomy of the bodily parts it is stated that the liver has five lobes, an idea, taken from the anatomy of the dog, which runs through the history of anatomy and was held by Vesalius in his earlier years.

Marinus of Tyre worked in Alexandria at about the beginning of the 2nd century. He wrote a number of anatomical treatises to which Galen gave high praise. Galen stated that he, Marinus, had collected many anatomical observations and everything described in his writings he had himself touched with his hands. A pupil of Marinus was Quintas who, though not important
himself, had two pupils Numisanus and Satyrus. These two had a considerable influence on Galen. It would seem that none of the second century anatomists was able to practise human dissection and that anatomy was in decay. For all his greatness Galen was only to codify the researches of antiquity for after ages.

Galen of Pergamum (A.D. 129 - 199) was, after the Hippocratic writers, the greatest of the ancient physicians. He was, himself, unable to carry out human dissection and had to make do with monkeys, in particular the Barbary ape. Galen states that only twice did he have the opportunity to study human remains: both times a skeleton. He seems to have been envious of his predecessors in this respect.

Like Aristotle Galen had strong philosophical views. He seeks to prove that the organs are so well constructed and in such perfect relation to the functions to which they minister, that it is impossible to imagine anything better. Thus, his work "Uses of the Parts of the Body" is not strictly about anatomy or physiology, but about final causes, to which those two disciplines are subservient. It is a justification of the ways of God to man. This view would have been particularly attractive to Christianity and is, no doubt, one of the contributory reasons for the preservation of Galen's work, rather than that of his predecessors.
Physiological System of Galen
Galen's work on osteology indicates clearly its simian origin, though this was one of the points most bitterly fought over following the appearance of Vesalius' "De Fabrica". Thus, Galen states that there are seven segments to the sternum, that the humerus is the second longest bone in the body and that the sacrum has only three segments. His section on muscles was probably mainly his own and in one or two instances he does indicate that he realises that the anatomy of animals is different from man. This section is bedevilled by the lack of adequate nomenclature.

His description of the cranial nerves lasted until the 17th century. He distinguished seven.

His description of the vessels is less satisfactory. The venous system is compared to a tree, the roots arising from the abdominal viscera, the trunk being the vena cava and the branches extending to the lungs, the right ventricle and throughout the body. A similar description of the arteries is given; the root is the arterial vein (the pulmonary artery), the trunk being the left ventricle and aorta. He rejected Aristotle's idea of three ventricles. Galen's physiology of the cardiovascular system is important, as it influenced anatomists considerably until the time of Harvey. It is shown diagramatically opposite. Leonardo da Vinci has a picture in his notebooks showing blood crossing the
intraventricular septum (as taught by Galen) and it was only in the second edition of the "De Fabrica" that Vesalius appeared really sceptical of the existence of pores in the intraventricular septum allowing this flow. The rete mirabile was of intrinsic importance to this physiological system; it was thought that in this organ the vital spirit was converted to animal spirit. Galen thought that the nerves were hollow vessels along which the animal spirit passed, giving rise to motor and sensory phenomena.

Following Galen, with the slow decay of the Roman Empire, there were no further anatomical works, and medicine was saddled with a faulty anatomical and physiological system, which lasted for over a thousand years. It was not until Vesalius came on the scene that Galen's teaching came under strong attack.

4. Anatomy to the 10th Century.

Traditions of Galen and Alexandria were maintained in Byzantium, but the results of this are unknown. The intellectual leadership passed to the Moslems in the 8th and 9th centuries, lasting to the 13th century. Greek medical writings were translated into Arabic. It is uncertain whether the Arabs carried out much original work; the answer to this question awaits the translation of documents. Greek was no longer studied in the Western world.
Throughout the latter half of the medieval period, medicine, law and theology were recognized as the only three branches of higher study. Medicine, the study of man, would have been second only to theology in the hierarchy of the medieval world. Anatomy, the study of dead bodies, would come lower. Salerno, though its fame lasted only two centuries, was one of the first Universities. The Renaissance was in every case characterized by a young mind working on old material, and nowhere in the Western world was this material available in greater profusion than in Southern Italy and Sicily. There the notable physicians collected, and a tradition of teaching arose. Medicine was the only subject taught at the University (recognized as such by Frederick II, 1234). It appears that Bologna University was founded following the break-up of the secular law school in Rome, due to the sacking of the town by the Normans in 1084. A medical faculty was certainly in existence by 1156. As Roman law was state law, as opposed to canon law, this resulted in the Italian Universities being predominantly municipal. The term "University" in medieval times did not refer only to the subjects studied, but to the international character of the students. Economically a University was important to a city, so the municipal authorities found it to their advantage to make sure of retaining the most eminent masters by the offer of a fixed salary. Previous to this, fees had been arrived at by
collective bargaining between students and the college of doctors. Ultimately all the teaching was done by the salaried professors. The only rights retained by the Bolognese and Italian University doctors were those of examination and conferring degrees. In other respects the professors were kept in subservience to the students. For example, they would be fined if they started teaching a minute late! Students had a very powerful weapon in the threat of boycotting individuals or seceding from the University. It was in this way that the University of Padua was founded in 1222.

In the North, particularly in Paris and Oxford, Universities arose from Cathedral schools. This gave the local Bishop considerable powers over the University and this was only slowly limited by directives from the Popes and various Councils, e.g. the Lateran. On the other hand, in the South, at Bologna, Pope Honorius III in 1219 decreed that nobody could be raised to the doctorate without licence from the archdeacon of Bologna.

Montpellier, in the medieval Kingdom of Aragon which had close connections with France, had a medical school of celebrity as early as 1137. It was influenced both by Salerno and by Arabian and Jewish medieval traditions.

The basic discipline of the schools was the lecture, or reading, of the master. In origin, in the developed medieval university, this would consist of a reading of an accepted authority, such as Galen, together with an exegesis by another accepted authority.
This technique can be seen to be ill-adapted to medicine and anatomy in particular, though of advantage in a discipline such as precedent law. In addition there arose the disputation, a formalized technique for discussing disputed points.


Having considered the institutions in which anatomy was to develop, we will pass on to the actual development.

The first recovery of medical material from the Arab sources not surprisingly occurred in Southern Italy at Monte Casino. The translator, Constantine the African (died 1087), was a monk. However, by far the most important translator was Gerard of Cremona (1115 - 1185), who translated in all ninety-seven works, including some of the Arab physicians Avicenna, Hali Abbas and Rhazes. As indicated earlier, Arab medicine depended upon Arab versions of Galen. Following the Aristotelian revolution in Europe and the acceptance of Moslem writings in Christendom, these translations had enormous influence. Thaddeus of Florence (1223 - 1303), who taught at Bologna, perceived the importance of direct access to the Greek sources as opposed to Graeco-Arabic, and encouraged translations of the Greek directly into Latin. He also taught people such as Mondeville and de Luzzi, who were very important in the resurgence of anatomy.

7. The Origins of Dissection.
Early in the 13th century Frederick II ordered all students who were studying surgery in Salerno to carry out dissection. However, this was limited to animals. The first certain record of a post-mortem examination was in 1288 by the Franciscan Salimbene in Parma. Post-mortem examinations are also recorded in Padua 1341, in Venice 1368, in Florence 1398 and in Genoa 1482. In 1299 Pope Boniface VIII issued the Bull, "De Sepulchris;" in which he stated that "Human dissection is horrible to us Catholics". He was referring to the preparation of bodies of knights killed on crusades, prior to being sent home. This statement was definitely not referring to human dissection for anatomical purposes, but it may well have helped to form popular opinion in its revulsion against dissection. It may have resulted in local prohibition: thus Crudo da Vigerano in Paris (1340) stated that the Church prohibited dissection. The body had in fact been partially dissected since the 9th century during the process of embalming. After the turn of the 13th century dissection for anatomical purposes, rather than for legal or religious reasons, appears to have been accepted. Henri de Mondeville, who studied at Bologna under Thaddeus and then departed for the University of Montpellier, brought out a book on surgery, which was illustrated with diagrams indicating that dissection had been performed. Mondius de Luzzi, another pupil of Thaddeus, wrote the "Anathomica" in 1316. This work was devoted solely to anatomy. It was written in very corrupt Latin and there was considerable
![Dissection scene from the Italian Fascicolo di Medicina printed at Venice in 1493. The picture forms the first page of an Italian translation of the Anathomia of Mondino. The professor in his robes is reading his lecture from his chair. A menial demonstrator dissects, as directed by the wand of the ostensor. Students in academic dress stand around and look on, but do not themselves dissect.](image-url)
confusion in the nomenclature. For example, the sacrum was called alchatius, allasius and alhavius in different parts. It appears that there was a limitation in anatomical material and the subjects were usually animals. Mondino dissected in person; this was an improvement, but as dissection gained formal inclusion in the University course, so the professor became more removed from the body; while he lectured a junior colleague, the ostensor, pointed out the line of dissection and a menial demonstrator performed the actual dissection (see opp.). Thus, dissection became just an illustration of the lecture which would have been taken from one of the ancient authorities. In his book first appears a reference to the seven-celled uterus probably culled from Michael the Scot (1174 - 1234). Mondino says he would not clean bones "owing to the sin involved therein". The study of anatomy followed a pattern similar to that of philosophical and theological studies of that time i.e. after the brilliant scholastic syntheses of Scotus and Aquinas in the 13th and early 14th centuries there followed the period of nominalism during the 14th and 15th centuries. This movement, partly because of prohibitions, lost all fecundity. Mondino's successor was Nicolo Bertucci who continued dissection, as did his pupil, Guy de Chauliac, whose book (1345) shows illustrations of anatomical dissection. However these scholars added little to the work of Mondino.

At Bologna dissection received official recognition in 1405 and Padua followed suit in 1429. Coupled with this recognition
DRAWINGS OF HEART BY LEONARDO

The Figure to the left is from Quaderni II, folio 3 verso and has been lettered according to modern notation.
The Figure to the right is from Quaderni I, folio 3. It is a diagram showing the structure of the heart and exhibiting the passages in the septum hypothesized by the Galenic physiology. It also shows Leonardo's looking-glass writing.

The drawing of the heart on the left shows a rare degree of naturalism. The drawing on the left shows blood passing across the intraventricular septum. This is inaccurate.
was the rule that no body should be obtained without permission of the Rector. Beyond the Alps dissection was recognised in 1378 in Montpellier and 1475 in Paris. In 1410 a post-mortem was performed on Pope Alexander V. Pope Sixtus IV (Pope 1471 - 84) recognised the opening of bodies conditional on permission from ecclesiastical authorities, and in 1523 Clement VII confirmed the practice. These regulations were probably introduced to stop grave-robbing and resulted in a restricted though regular supply of corpses. As there were no preservative methods in those days, the few dissections that were performed had to be finished quickly.


Since ancient times there had been a few diagrams produced illustrating what tradition required. All of these had been of a very crude nature both artistically and medically. The impulse for naturalistic anatomical depiction seems to have come from the artistic world. Mostly the artists kept to superficial structures, for example Verrachio (1435 - 88), with the exception of Leonardo da Vinci. However, the latter's work was never published so his only influence could have been by personal contact. Vasari refers to a work on anatomy by Leonardo but he was probably referring to the projected, but never fulfilled, work with Marcantonio della Torre. As there is no other record of this,
Fig. 51.—From the Italian *Fascicolo di Medicina* printed at Venice in 1493. The anatomy though very erroneous exhibits the uterus naturalistically treated. This is the first figure in a printed book in which an internal organ has been drawn from the object. Some have thought the figure was drawn or at least influenced by Leonardo; note the curious lateral projections from the body of the uterus and compare them with those in Fig. 50.
we must assume that his work had no effect on his world.

The difficulty of connecting nomenclature to diagrams became apparent. We also see an interesting ambiguity illustrated in the diagram opposite where the artist has partially copied from life and then added other structures to appease tradition. Initially these naturalistic pictures were not integrated with the text; moreover printing was not sufficiently developed to allow of their widespread dissemination. On the other hand there were some very good diagrams of flowers printed towards the end of the XVth century. The first instance of naturalistic diagrams in medicine is the "Fascicula di Medicina" printed in 1493. (see opp.)

With Alessandro Achillini (1463-1512), who taught at both Padua and Bologna, anatomy seems once more to be stirring. He described Warton's duct and the trochlear nerve, he improved the description of the gut and also questioned the existence of the rete mirabile in the human. Following Achillini and partly contemporary with him was the Professor of Surgery and Anatomy at Bologna (1512 - 27), Giacamo Berengario da Carpi (1460 - 1530). During his professorial period he performed many dissections and wrote two books, in 1521 the Commentario on the text of Mondino, which consisted in reality of not only a commentary on Mondino but an extension of his anatomical knowledge; in 1522 - 23 the
These Muscle-men in the original are anatomically correct and artistically pleasing. Compare with the skeleton below.
Isagoge Brevis. Carpi was the first to describe the vermiform appendix, the first to see the arytenoids as separate cartilages and the first to give a clear account of the thymus gland. His diagrams are of a highly variable nature. The surface muscles are accurately portrayed and the whole design is artistically pleasing; (see opp.). On the other hand his skeleton is artistically poor and anatomically inaccurate. (see opp.) His Latin is very debased and he was responsible for the introduction of the word "synovia" into anatomical vocabulary; this word was invented by Paracelsus. Berengario's publications are notable for their hesitation in following the ancient authorities, in particular Galen. Historians, as early as 1490, had indulged in a critical approach to historical texts.

The most fully illustrated works of pre-Vesalian anatomists were those of Estienne and Canano. However, though their work was in preparation before the "De Fabrica", nothing was complete until after the appearance of Vesalius' work.

9. The Humanists and Nomenclature.

We have seen that some medical works were preserved at Salerno. To this were added translations of Arabic texts which drew on Greek sources. During the 15th century direct translations from
Greek sources, such as Galen and Aristotle, were made. Hence at the
time of Vesalius there was considerable confusion over nomenclature.
The humanists finally won the day and in the main anatomical terms
are derived from Greek sources via Latin. Allessandro Benedetti
(1455 - 1525) who marked the start of the rise of the school of
Padua was particularly important in this respect. His "Five Books
of the Anatomy of the Human Body" contain no new facts but appeal
directly to the Greek Galenic texts.

Part II. The Life and Work of Vesalius.

1. The Forebears of Vesalius.

The family was originally called Witing and came from Wesel.
Vesalius claimed in his letter on the China Root that his great-
great-grandfather was Peter Witing and that he had attended
Emperor Fredrick III. However, there is no independent corroboration
of this so it may just be a pretty family tradition. There is more
documentation of Vesalius' great-grandfather John Witing. He took
the name of Johannes de Wesele, thus distinguishing his branch of
the family. In time this was replaced successively by Van Wesele,
Vesule and Vesalius. In 1429 he appears on the matriculation list
of the University of Louvain. In time he rose to the position of
Professor of Medicine, City doctor, magistrate and possibly to physician to Duke Charles. During his career he amassed a fortune which lasted until after the death of Andreas Vesalius. Johannes' eldest son Everard was also successful in medicine and rose to the position of physician to Archduke Maximilian, Regent to the Netherlands. Everard had an illegitimate son, Andries van Wesele, by Marguerite Winters. This son qualified as an apothecary and lived in the Rue Haute section of Brussels. This section was near the place of execution, where the bodies were allowed to rot. Andries was the Imperial pharmacist and this kept him away from home for long periods. It was into this home that Andreas Vesalius was born, being the second son. Very little is known of the older son Nicolo.

2. Youth of Vesalius in Brussels and Louvain.

Andreas was probably born on 31st December. For lack of other evidence it can be assumed that he went to school under the Brothers of the Common Life in 1521, where he would have learnt grammar, rhetoric and dialectic. It seems that Andreas went to Louvain in 1529 and his name appears in the list of matriculated students in the archives of the University. The University was divided up into a number of schools which would approximate to colleges, as in the Oxford and Cambridge tradition. Andreas entered
the Castle school whose regent was Cornelius Browers. The latter had many commitments elsewhere; he was rector of St. Donation in Bruges, and Governor of the College of St. Jerome at Leyden, so most of the teaching would have been under the supervision of the subregent, Johannes Scardye. The school was strongly humanist in bias and the curriculum contained Latin and Greek grammar, language and literature, together with philosophy and rhetoric. Part of the course included Aristotle's "De Anima" and Vesalius states in the "De Fabrica" (143 p. 623) that he had some lectures on anatomy. He also refers to some embryological theories in the "Secreta mulierum et Virorum" (probably by Albertus Magnus). Vesalius must have been interested in anatomy at this time as he discussed the formation of the foetus in the "seven-celled" uterus with a lawyer relative, Guillame Martin Stein, ("De Fabrica" 143 p. 531). It is also said that Vesalius began dissecting animals at the age of 16. Vesalius obtained a considerable fluency in Latin when he was at the College, but the extent of his Greek is unknown.

Whilst at Louvain Vesalius met two contemporaries, Antony Perrenot, who rose to be a Cardinal and Primate of the Netherlands, and Gerard van Weltwyck, who entered the imperial diplomatic service. These two may have been influential in Vesalius' decision to leave Padua and become an imperial physician.

It is uncertain when Vesalius decided to study medicine.
Certainly the legitimisation of his Father in 1531 made the possibility of a more exalted career than pharmacy open to him. It seems likely that the friend of the family, Nicolas Florenas, a physician, was influential. This man, who acted "In loco parentis" during the Father's long absences would have been able to give the advice Vesalius needed and the latter obviously held him in high regard. In the dedication of Vesalius' first published writings "Paraphrasis in novum librum" published in 1537, the writer speaks of Florenas even more highly than conventional flattery would require. Florenas had gained his M.A. at Louvain and later his medical degree. He travelled widely, going to Bologna, Arras and Bruges. Again, he would have known that the standard of medical teaching at Louvain was low, and he may have advised Vesalius to go to Paris, even though his great-grandfather Johannes had been professor of medicine at Louvain.


In 1533 Vesalius set forth for Paris. At the age of 19 he would have been too young to graduate M.A. from Louvain, but it was usually possible, on coming of age, to be promoted. The term opened on 14th September and he was probably lodging with his friend from Louvain, Jean Sturm. Little is known of his student life. To sit the exams for his doctorate at Paris he needed his Baccalaureat, his M.A. degree, and to have spent 36
months in study. This was equivalent to 4 academic years. Hence the three years he spent at Paris were not sufficient for him to petition for examination.

Paris University rose to its pre-eminent position in France during the life of Abelard. Initially, it was a centre of scholastic teaching; both Albert the Great and Aquinas taught there. Later it came under nominalist influence as the movement spread from Oxford, and later still the Averrosists gained ascendancy. With these latter there was a great respect for Aristotle and his teaching, and this proved a fertile ground for the humanists. This, together with the fact that Paris University had greater connections with the Church than the Universities of Northern Italy, combined to make the intellectual climate conservative, in particular with respect to the criticism that Vesalius was to launch against the ancient authorities. It is no accident that the most virulent attacks on Vesalius originated from this University. However, that was in the future.

The Dean of the Faculty was elected at four-year intervals by four electors, each representative of one of the four regions from which students were drawn - France, Normandy, Picardy and Germany. The Dean was in charge of the curriculum which included Materia Medica, Pharmacy, Physiology, Pathology, Anatomy and Surgery. He also presided over the examinations of the surgeons and apothecaries. Teaching by professors was from 8 - 11 a.m.
and from 2 - 4 p.m. Courses were also given early in the morning by bachelors. These lectures were taken directly from writings of the authorities. At this time the contents of the University library shifted in emphasis away from the medieval and Arabic writings to Latin translations of the Greek writers. Jean Vasses, who was Rector when Vesalius arrived in Paris, was active in this re-orientation towards humanism.

The first recorded dissection in Paris took place in 1407, and regulations on dissection were not introduced until 1478. Thus Paris was late compared with other European Universities. Major surgery was under the jurisdiction of the Guild of Surgeons, whilst minor surgery was under the Guild of Barbers. Towards the end of the 15th century the medical authorities attempted to control the activity of the Guild of Surgeons, whilst at the same time considering surgeons to be rather inferior. This resulted in hostility between the two groups. Anatomy was taught by Professors of Medicine sitting in their high chairs using texts of Guy de Chauliac or Galen. Perhaps it was with reference to some of his experiences in Paris University that Vesalius wrote (De Fabrica 43, p. 515): "Self-satisfied Prometheans sitting in their high chairs and disdainful of dissection". All these factors must have contributed towards making the standard of anatomy low compared with that of the Italian Universities. Anatomists such as Mondino, Achillini and Berengario were ignored, so Galen, whose anatomical work was printed in Paris in 1528, quickly gained a prominent position.
There were two teachers in Paris who made a lasting impression on Vesalius. Jacobus Sylvius, 1498 - 1555, of Amiens, studied anatomy under Jean Tugault and gained his doctorate in Medicine at Montpellier in 1530. From there he came to Paris and started teaching at the College of Treguier in 1531. This college was not part of the University. Sylvius insisted on doing his own dissection and Vesalius speaks highly of him as his teacher both in the 1543 edition of the De Fabrica and in his Paraphrasis. It was only in the letter on China Root that Vesalius made adverse comments on him following Sylvius' abusive attacks on himself. In the 1555 edition of the De Fabrica Vesalius maintains a dignified silence. Elsewhere Vesalius (letter Basel '46) states that Sylvius taught him only on lower animals and accuses him of adhering too closely to Galen. However, Vesalius may have had a rather jaundiced view of his teacher at this time. Certainly, in Sylvius' Isagogue he doubted the intercommunication between the two ventricles of the heart, and also the existence of the rete mirabile in humans. He always refused to publicize Galen's errors. Sylvius' muscle nomenclature was better than Vesalius'. However, Sylvius retreated from this position as the controversy with Vesalius developed. Whilst he was in Paris Vesalius met Dryander, the future professor at Marbourg and plagiariser of Vesalius' drawings. He must also have met Charles Estienne, who was to be influential in Parisian anatomical circles.
Vesalius' other anatomical instructor was Guniter of Andernach. Guniter was not a particularly good anatomist, but was a prominent humanist. It was possibly of Guniter that Vesalius made the remarks about Prometheans quoted before. In the main the relations between the two seem to have been good. He refers to Vesalius in his book Anatomica Methodus" (1535). He also had some influence on nomenclature, replacing some Arabic words and introducing terms such as "trochanter" and "gastrocnemius". In the "Anatomica Methodus" he states that Vesalius had discovered the spermatic veins which had, in fact, been described at length by Mondino. It seems that students had an opportunity for dissection.

4. Louvain.

In 1536, following an incursion by France into Northern Italy, the Emperor Charles V ordered the imperial army to advance into Provence, and another army to advance along the Flemish border. The Flemish were singled out by the French as particular enemies. Vesalius thus became an enemy alien in France and, diplomatically, departed for Louvain, which he entered in the new academic year in 1536. He writes (De Fabrica '55 -p.658) of taking part in an autopsy of a young girl in 1536.

Louvain was very conservative in its studies. This is perhaps best illustrated by the words of the Professor of Medicine, Arnold Noots: "I would prefer to be wrong with Avicenna
rather than right with a Greek physician". Some years later Noots with the other professor of Medicine, Leonard Willemse, was expelled from the University following complaints from the students. Vesalius refers to these teachers in his venesection letter of 1537. They obviously provided no inducement for him to stay in Louvain.

While at Louvain Vesalius submitted his thesis for bachelorhood of medicine in Feb. 1537. He also had it published. This work, "The Paraphrasis", was dedicated to Nicholas Florenas and was a translation of Rhazes "Therapeutics". Vesalius did not have any knowledge of Arabic and the work was in effect a stylistic improvement on a previous translation, together with some comment and identification of drugs. Vesalius attempts to show that Rhazes was saying the same as Galen, but not always successfully. This was obviously an attempt to synthesize the two traditions of Paris and Louvain in which he had been taught. Rhazes taught categorically that it was dangerous to draw blood off from a site near to the ailment. This drew Vesalius into the venesection controversy which was to occupy his thought for some time; Vesalius presented the new procedure in which blood was drawn off near the ailment. The work shows no sign of free enquiry, but it may have brought home to Vesalius the inconsistencies of the authorities, and have influenced him to depend more on empirical methods later in his life. It appears from
the second edition of the work which was printed in 1537, that Vesalius had gained his bachelorhood.

After March 1537 all trace of Vesalius is lost until December 1st. He probably went home to decide the next step in his education. Nicholas Florenas may have been influential in suggesting North Italy. France was still impossible, as the war with the Emperor was continuing. He could have gone to Bologna, but possibly it was the rising fame of Padua which persuaded Vesalius to go there.

5. Padua and the Tabula Anatomica (1538).

The University was founded in 1222 and given the title of Studium Generale in 1246. In 1346 statutes regulating dissection were passed. Initially, the University was politically under the Duke of Carrara, but in 1440 Venice conquered Padua. Both powers fostered the growth of the University and during the 16th century it became the most famous medical school in Europe. The statutes of the University were geared to encourage change. The professors were not allowed to repeat exactly the same course of lectures annually. Secondly, they were required to give a certain number of lectures annually, and they were not allowed to leave the town without express permission from the rector. In Padua, unlike Paris, the theological faculty was not pre-eminent. Venice was anti-clerical and certainly anti-papal in outlook. As
well as a developing tradition in anatomy founded by Bendetti and in humanism by Montanus (note, however, the physicians were more Galenist than Aristotelian) there was some expression of scientific method. Augustino Nifo wrote (1506, "On the Physics of Aristotle"): "It seems to me that in the regress made in physical demonstrations the first process by which the discovery of causes is put into syllogistic form, is a mere hypothetical syllogism, since through it the discovery of the cause is syllogized in a merely conjectural fashion. But the second process by which is syllogized the reason why the effect is so through the discovered cause, is demonstration". Thus, Nifo is describing the process of hypothesis and implying the necessity of demonstration and empirical investigation. Whether this type of thinking had any impact on Vesalius is unknown. At the same time as Vesalius' stay in Padua, a Doctor at Venice, Nicolo Massa, produced a book on anatomy which was critical of Galen, e.g., he rejected the 5-lobed liver. Though Vesalius did not acknowledge him, he could have been a considerable influence.

**Vesalius' academic qualifications, his three years at Paris and one year at Louvain, together with his M.A., satisfied all the regulations of Padua, with the exception of a practical course in visiting the sick, for taking his doctorate. He completed this, and on December 1st, 1537, took his doctorate, which, according to Roth (Moritz Roth, *Andreas Vesalius Bruxellenin* 1892), quoting the Archives of the University of Padua, Vesalius passed well.**
Vesalius was immediately given the chair of anatomy and surgery, though no record of this appears until his re-appointment in 1539, in the University archives. He succeeded Paolo Colombo of Cremona. The reasons for his being given a chair so quickly are rather obscure. From his examination results Vesalius must have created a good impression at Padua. The chair itself was not very important. Initially, he was paid 40 florins annually, which rose by 1542 to 200 florins; this was small compared with the income of 1000 florins annually paid to Crambattista da Monte, the senior physician at the University. The practice of appointing a recently graduated student to the chair was repeated with Columbo after Vesalius' retirement. The fact that he had been mentioned by Gunther of Ardemach would not have been particularly important, as the latter, though a prominent humanist, was not an important anatomist. Finally, Vesalius' Paraphrasis could have been no recommendation.

Vesalius' duties were to give one lecture daily and also two public disputations each year. It is uncertain where these lectures were given until 1542, when the University acquired a local public house "Il Bo". This is probably the reason for the small ox head on the title page of the De Fabrica.

A record of Vesalius' first lectures has come down to us in the form of notes taken by Vitus Tritonius, who had been a student at Padua from 1535 - 38. He appears to have been a friend of
Vesalius (F. 'L3 p538). These notes comprise nine pages of surgery and twenty of anatomy, suggesting the emphasis that Vesalius was putting on anatomy. Tritonius draws attention to another difference compared with his predecessors. The University statutes stated that dissection of human bodies should be carried out by a surgeon; a physician should read the text of Mondino, whilst a second physician should demonstrate the dissection. However, right from the beginning, Vesalius did his own dissecting and lecturing. This was a courageous step for Vesalius to take, as dissecting was regarded as a menial task and this would automatically cause him to lose status in the eyes of his academic colleagues. With respect to posterity this was one of Vesalius' most important contributions to anatomy. Rabelais is said to have dissected in person whilst staying in Lyons in 1537, and Sylvius in Paris in 1535, but there were no precedents in Italy. The text of his lectures suggests that Vesalius was depending mainly on Gunter of Andermach and Galen. He refers to the AZYGOS vein draining the thoracic cage and, unlike Sylvius, does not hesitate to say that he was disagreeing with Galen. Referring to this period Vesalius writes in his letter on venesection (printed Basel 1539): "I gave careful thought to the consideration of the possibility that anatomical dissection might be used to check speculation". This again, in its emphasis, was a break with the past. Berengario had done this in a minor degree in 1525. As has already been stated,
anatomical dissection was used only to illustrate the work of the ancient masters. It also suggests that Vesalius was finding it difficult to justify some of Galen's doctrines with the visible evidence of dissection. At the time he was giving these lectures he made one or two diagrams in particular of the venous system in illustration of his contentions on the practice of venesection. Arising out of this, his students asked him to publish diagrams not only of the venous system but also of the arteries and nerves. Later, pictures of the skeleton were also made, and the result was the Tabula Anatomicae.

The Tabula Anatomicae appeared in 1538. This again was a break with tradition. Sylvius, Ferrel, Guinier, Massa, Colombo all did not employ diagrams in their books. Only Carpi, Charles Estienne and Eustachio used diagrams; Eustachio's diagrams were published after his death. Diagrams had also appeared in some vernacular textbooks intended for barber surgeons. Some physicians considered that the use of diagrams was wrong as they detracted from concentration on the text. The pictures themselves were originally $17\frac{1}{2}''$ by $13\frac{1}{2}''$, and this in itself was a considerable technical feat with woodcuts. The first three diagrams, the non-skeletons, are probably by Vesalius alone and show considerable mastery of draughtsmanship and shading. The other three are by Johannes Stephanus from Calcar. With the diagrams is a short commentary; thus text and illustration were integrated. With the Tabula there was also the best multi-lingual anatomical
Two skeletons from the "Tabulae Anatomicae".
Vocabulary up to that date: Vesalius was attempting to deal with the terminological problem.

In the first plate the right kidney is shown as lying higher than the left. This occurs in domestic animals as well as in the ape. In the small picture he shows the prostate for the first time. Massa described it in his book in 1536. In the second plate he draws the ungulate venacava; in the De Fabrica 1543 edition the venous system is more simian. In these animals the superior and inferior vena cavae appears to be in direct continuity. Still-born infants were also probably used as anatomical material; Massa certainly refers to dissecting them, and again here the vena cavae give the impression of continuity and it may have been in this way that this error occurred. In the third plate of the arterial system the aorta and heart are not of human origin, but simian, see opp. p. 50. A common trunk giving off both and the right subclavian is shown. The last three plates are of the skeleton. Plate VI shows an exaggerated symphysis, a poorly articulated clavicle, a sternum with seven segments and a very poorly drawn left scapula, see opp. p. 43. Plate V shows a gross error in pelvic tilt and in the spinal curvatures. Plate VI shows errors in the width of the sacrum and lumber vertebrae, see opp. The promised plate showing the nerves did not appear. It seems that the drawing that Vesalius prepared was stolen and later published by Macrolius in Cologne.
The Tabula represents a transition period in Vesalius' career. He was no longer a complete Galenist and had come to realize that Galen was not infallible. For instance, Vesalius writes: "The descriptions of Galen are not always consistent. I have observed that they do not suit these two bones (coccyx and sacrum)". Vesalius had easy access to bones from graveyards and criminals, whilst much of his dissection had to be performed on monkeys and hence confirmed Galen's errors.

Judging from the number of pirated versions that appeared, the Tabula was very popular. Versions appeared in Augsberg printed by Jobst de Necker, in Cologne by Macrolius, in Strasbourg by Ryff, in Marburg by Dryander and in Paris by Estienne, Kever and Togault. The Ryff version superimposed the diagrams on the body and tinted them. The effect, artistically, was appalling. Often these plagiarisms were of very poor quality and Vesalius repeatedly attacked them for this poor quality, particularly in his letter to Oporinus.


In May of 1538 Vesalius completed a revised version of Guiniter's Institutiones and it was printed in Venice that year. We have no record of Vesalius getting Guiniter's permission for this. Further, Vesalius added a new dedication to his former teacher, Armentarianus. Possibly Vesalius was thinking of
returning to Louvain. This makes Vesalius' complaints of other people copying his work look like "the pot calling the kettle black". In the foreword he talks of anatomy being perfected by Galen and also of Guinter as generous and learned. Vesalius added much detail to the book, especially on dissection technique, in which he was very proficient. Characteristically of those times Vesalius did not delete Guinter's praise of himself. Guinter brought out another edition of his book in Paris in 1539 and used many of Vesalius' changes.

Between August and September Vesalius went to Bologna to meet some of Nicolas Florenas' friends. Among them was the physician Matteo Cortti. They argued about venesection and, in particular, whether veins had three layers of fibres in their walls as did the gut, Vesalius maintaining that they did. It was only in 1564 that Vesalius finally came to admit that he was wrong. This precipitated Vesalius into writing his letter on venesection. Intrinsically it is of little worth and mainly centres round the controversy whether the veins should only be cut as far away from the ailment as possible to draw the humours away, as was maintained by the Arabs, or whether it could be done close to the ailment as well, as was considered by the classical authorities. In this letter he remarked that he thought the pulse and systole to be synchronous, a point that was to trouble Harvey for a long time. (The reverse was stated by Galen).
In January 1540 Vesalius got permission to go to Bologna and lecture there. He stayed with a friend, Giovanni Bianchi. Very luckily a record of these lectures has come down to us. A student, Baldasson Heseler from Leibnitz, born in 1508, studied theology under Martin Luther at Wittenberg and later passed on to Bologna to study medicine, where he took notes which have been preserved. He obtained his doctorate in 1540 and practised in Breslau. The manuscript was discovered in 1959 in the library of Stockholm by Ruben Eriksson.

From these notebooks we get a very clear picture of Vesalius' techniques of teaching, on debating points with his colleagues and on his character. We also get information on his views on anatomy and his attitude to ancient authorities. At the same time that Vesalius was doing his anatomical dissections and lecturing on them, the physician Boriti was giving a series of lectures based on Mondinius.

We will first look at Vesalius' pedagogic technique. Firstly, Hessler states (Fol. 27n) "However, he put on the dissection table his anatomy of bones (a skeleton) from which he on every occasion all the better demonstrated to us the part." Vesalius thus used the skeleton as the framework on which to build up the students' knowledge of the soft parts so that they could more easily conceptualize the relations. In a similar vein, (Fol. 30b-31a)
Hessler states "And before he demonstrated the dissection of the muscles, their position etc., it is necessary, he said, for you beforehand to know the anatomy of the bones." Vesalius also used animals in his demonstrations partly for the purpose of comparative anatomy, partly to suggest where Galen had got his ideas from, and finally probably partly because of the lack of anatomical material. (Fol. 132) He uses a dog's larynx to demonstrate the muscles. (Fol. 27a) "And they killed a dog upon which he showed that the muscles in dogs as also in other animals were fastened in quite another way." Where it was possible, and when Vesalius considered it particularly important, he got the students to file past the body and verify with their own eyes the truth of his statements. Thus in Fol. 101a "Then we all had to go out so that only a few at a time would see it in good order........With great emphasis he demonstrated to us the bile ducts which first go from the liver towards the gall bladder and then bend towards the duodenum. Seldom, he said, does a preternatural bifurcation of the bile duct occur, one branch of which bends towards the stomach." He also got the students to feel the contractions of the heart of a dog and showed that they were synchronous with the pulse. Finally, as an aid to clarifying his dissections, Vesalius would sometimes sketch the relevant parts on the dissecting table (Fol 52b-53a). It must have been rather difficult for some of the spectators to see round the corpse to the diagram. Vesalius does not seem to have used a blackboard. He also advised the students to read up the relevant texts before the dissection. (Fol. 27a)
In debating points with colleagues Vesalius seems at times to have been rather tactless and impetuous. He was under extreme provocation. Thus, in Cortti's opening lecture, he states that any addition that Mondinius made to Galen were wrong. The sole function of his lectures seem to have been an effort to explain away conflicting ideas between the ancient authorities such as Averroes and Galen. At times Vesalius seems to positively to bait his colleagues. Thus (Fol. 30b-31a) Vesalius described the muscles in Galenic style "even if, as he sometimes said, Galen had not known all this - at this point Corttius, Boccaferrius and Eregius walked out." At the first demonstration there was an interchange between Vesalius and Corttius. Hessler describes Vesalius as irascible, ambitious and that he aspired above all to advance new theories. At the same time Hessler remarks that Corttius is vainglorious and ignorant.

It is obvious by this time that Vesalius regarded some of the ancients' teaching as suspect. (Fol. 64a-68b) "There is no truth in what other people say about the five lobes of the liver, they are only "flaps that cover the stomach". This contradicts his diagram in the Tabula. Vesalius described the impossibility of the sideways movement of the head as detailed by Galen. On the other hand, perhaps remembering his exchanges with Corttius, he sometimes sidesteps the authoritarian issue and suggests that Galen has been
mistranslated (Fol. 47b - 48a). "Then he dissected the muscles of the jaws showing us the origin from the bones, as Galen describes all in due order in the quoted passages. However, he said that some passages of Galen had been wrongly translated, as could be seen from the dissection". Naturally, Vesalius was not in a position to restart anatomy, though he had realised the limitations of the sources from which he had been taught. He used both the ancient authorities and his own observations. He used a sheep's head to demonstrate the rete mirabile and implied that it exists in man. He also accepted without comment that blood passed through the intra-ventricular septum. However, Vesalius expressed this opinion: "Feel with your hands and trust them" - a thoroughly empirical approach. He did not always carry out this precept, for example (Fol. 91b) he states that only male foeti could be born in the left horn of the dog uterus, as it was warmer. When his findings were against the physiological system put forward by Galen, Vesalius was rather more loth to find fault. It took him many years to convince himself that the rete mirabile did not exist and it was only towards the end of his life that he rejected the existence of pores in the intra-ventricular system. His mode of writing, like that of his contemporaries as well as the ancients, was to much things in teleological terms. Galen's physiology gave a framework upon which he could hang this teleological thinking.

On balance Vesalius probably regarded the lectures at
Bologna as a success. He attracted large audiences and apparently had the support of many students and possibly some of the staff. On the other hand, he certainly antagonised other members of the staff. None of them had been able to show Vesalius that he was wrong.

7. Padua to 1542.

Vesalius returned to Padua in February 1540. According to John Caius (De Libris propriis pp. 75-76), founder of Caius College and also future President of the College of Physicians in London, he shared lodgings with Vesalius and at that time Vesalius was working on the De Fabrica.

Also at this time Vesalius and Caius were both working on the Quinta edition of Galen's works. The Quinta family came originally from Florence. They had already published two editions of Galen, but the new edition was meant to be the definitive version. The translation was carried out by scholar physicians. Vesalius had been asked to make some emendations in the part that he was engaged on, namely, the Anatomical Procedures by some colleagues such as Gadaldino. However, he made very few and few parts were criticised as being inaccurate. It may seem surprising that Vesalius should have been asked to do this. However, he had a rising reputation, even if it was for being critical of Galen. It has been suggested that Vesalius' grasp of Greek was
poor, but the fact that he was able to carry out this task accurately, that Gunter, an eminent humanist, had spoken well of his ability in Greek, together with his education at Louvain, would indicate that he was a good Greek scholar. The translation was probably based on an earlier one produced by Gunter. It proved that Vesalius was very familiar with the works of Galen and that he knew what he was criticising. It closed the loophole of the charge that he was using poor translations of the ancient authorities. It was over his attitude to Galen that Vesalius and Caius fell out. The latter refused to accept Vesalius' criticisms of the "Prince of Physicians".

At this time Vesalius made two other friends. The first was Marcantonio of Genoa, who became professor of philosophy in Padua and is mentioned in Vesalius' foreword to the De Fabrica as encouraging him. The other was Peter Hewart of Augsburg, who was possibly of financial help to Vesalius when he brought out the De Fabrica. Vesalius wrote for him a concilium for a young man going blind. In this Vesalius shows himself completely dependent on Galen and Hippocrates in his diagnoses and treatment.

Vesalius had apparently satisfied the authorities with his teaching, as his income was raised to 200 florins in 1541. This means that his innovations and criticisms of the authorities in
anatomy must have met acceptance by the majority of the faculty. Realdo Colombo was put forward as an assistant to Vesalius. He came originally from Cremona and was related to Paolo Colombo, the previous incumbent of the chair of anatomy and surgery. Initially relations between the two (Vesalius and R. Colombo) seem to have been good. On their future relations see p. 54.

8. The Preparation of the "De Humani Corpus Fabrica Libri Septus". 1540 - 1542.

It is uncertain when he finally formulated his plans for the De Fabrica. He writes of his intention of bringing out a major work in the Tabula and more confidently of doing so in the Venesection letter. His reception at Bologna may have finally confirmed his intentions. In his letter on the Chines Root he remarks that he had lectured three times on Galen's book "On the Bones" before he dared draw attention to his inaccuracies. As he started lecturing in 1537 this puts the date at 1540. Caius, as previously stated, remarks that Vesalius was engaged on the De Fabrica in 1540. Thus, the De Fabrica was written from between 1539-1540 to the summer of 1542. The immense output in such a short time can only be accepted if it is remembered that Vesalius was a young man of 25 to 28 during this period, that he had no family ties and, finally, that much of the material must have been worked out during his previous lectures.
Vesalius intended this monograph to provide the fullest possible description of the human body. He made use of the previous descriptions, but it was his plan to verify them all from human dissection. This he managed for half the book, in particular those parts referring to the bones, muscles, heart and brain. The remainder is more traditional, but all parts bear the stamp of Vesalius' empirical approach. Vesalius probably saw his work as returning to the purity of the Alexandrian school.

Vesalius had rather more anatomical material to carry through these intentions than was allowed by the University. As well as public dissections he carried out private dissections at his own house, using bodies rifled from tombs (letter on the China Root, published Basel '46). He had the cooperation of a sympathetic judge, Marcantonio Coaturini, in obtaining bodies. He even made the time of execution of the criminal suit the convenience of the anatomist (Fab. 1543, p. 650). It is impossible to estimate how many males he dissected, but during the period of preparation of the De Fabrica he dissected about seven females – four provided by the University and three from rifled tombs. One of these was the mistress of a monk, who died suddenly. The students who stole the body had to flay it quickly, as the girl's relatives were appealing to the judges to find the body (Fab. 1543, p. 538). By this type of anecdote he tacitly encouraged such practices. In 1550 the Venetian State increased the penalty for body-snatching.
In his public dissections Vesalius lectured and demonstrated whilst a student carried out the dissection. In private, he both dissected and lectured (De Fabrica 1543, p. 547). It was by his close application to dissection of humans and animals that he was able to show that Galen depended on the monkey, and hence that the latter's work was suspect. Vesalius also encouraged research on the living body, for example, "compression of the nerve at the elbow indicates the distribution in the hand". (De Fab. 1543, p. 395). He was awake to the existence of anomalies and says: "I am not accustomed to say anything with certainty after only one or two observations". (De Fab. 1543, p. 124). Not only does this show that he was aware of these pitfalls, but it also suggests almost a methodological doubt, thus pre-figuring Descartes. His passion for direct enquiry went to such limits that he examined the "still pulsating heart and rest of the viscera of a wretch just quartered alive". (De Fab. 1543, p. 78).

Vesalius' verbal description of anatomy was much hampered by the inadequate terminology of that time. He would describe structures by analogy: the mitral valve was said to look like a bishop's mitre, trapezius like a Benedictine's cowl, and the pectoral bone like a sword. He used not only the Greek and Latin names, but also listed the Arabic and Hebrew names. He maintained the ancient teleological way of expressing his arguments. However, he tended to regard the structure as the key to the purpose, rather than the other way round.
It is unknown how much the Italian anatomists influenced him. Certainly, he had not read Mondino, Achillini or Berrongio da Carpi whilst he was in Paris. He may well have come into contact with Nicolo Massa, the Venetian physician. It seems more than a coincidence that Massa should have been the first to describe the prostate and for Vesalius independently to find it and show it in his Tabula. Massa himself performed autopsies at two Venetian hospitals and emphasised the need for dissection. He also remarks that it would be advisable to discover whether apes are similar to or different from men. Vesalius knew the ancients well and, in particular, was translating Galen at the time of writing the De Fabrica.

There has been much controversy as to who was the artist involved in the De Fabrica. Vesalius writes in his venesecction letter: "If bodies become available and Johannes Stephanus (of Calcar), the distinguished contemporary artist, does not refuse his services, I shall certainly undertake that task". Vasari, writing in 1568, refers to Calcar as illustrating Vesalius' work. The reference is imprecise and he could well have been referring to the Tabula. In fact, it seems that the pictures and diagrams came from more than one hand. The artist and the anatomist worked in collaboration, and there would usually be written beside the illustration: "We have represented - ". In some of the more primitive illustrations, especially of the uterus, appears: "I have represented - ". Possibly this illustration was from the
A Skeleton from the "Tabulae Anatomicae".

Note the relative crudity of the skeleton from the Tabulae. The pelvis is out of proportion and wrongly angled. The clavicle is misarticulated.
body of the monk's mistress, where Vesalius was rather pressed for time! Caius writes (De Librii prppiiis): "During that time Vesalius wrote and illustrated his book". That Vesalius was a competent draughtsman has been shown by the Tabula. The illustrations in Vitus Tritonius' notebook are substantially the same as in the Tabula. Finally, in Vesalius' letter on the China Root, he complains bitterly of Geminus plagiarising his pictures of the blood vessels, which he, Vesalius, said he had depicted. All this suggests that Vesalius may have been the originator of many of the diagrams in the De Fabrica. However, illustrations such as the frontispiece, the muscle-men and the skeleton, would have been beyond his capabilities. They would appear to have been beyond the capabilities of Calcar as well. If the drawings of the skeletons of the Tabula and the De Fabrica are compared, see opp. 43 and 30-47 it can be seen that the latter are immeasurably superior. At the time Calcar executed the drawings for the Tabula, he was 39, and probably at the height of his technical abilities. He was, therefore, incapable of producing the drawings. The most likely possibility is that they were executed by an unknown painter of Titian's school. Somebody of that ability could have remained unknown only if he had died soon after completing the task. Vesalius was probably aware that his book was of epochal significance. The rather bizarre background to his muscle-men, see opp. p. 48 (which can be identified with the Euganeun Hills, six miles southwest of Padua), and the use of decorative capitals again of a
An initial from a chapter-heading of the "De Fabrica".

This illustrates killing a dog prior to using it for anatomic purposes.
rather bizarre content, see opposite. Suggest not only a whimsy or fancy, but also a desire to make the book a work of art as well as of science.

The woodcuts were made in Venice and probably no better technical job could have been done in Europe. The book itself was printed by Oporinus in Basel. Oporinus had been a scholar and became professor of Greek and Latin in Basel. As he never gained his doctorate he had to give up his position. Following this, he went into printing, together with three colleagues. By the time of the printing of the De Fabrica in 1542, he was the only remaining partner. In the past, this company had printed for Vesalius both his Paraphrasis and his Venesection Letter. Perhaps Vesalius selected this printer partly because he liked Oporinus and partly because he had done a good job before. The production of the De Fabrica was a considerable financial risk to the printer, and Oporinus seems to have been willing to take such a risk. He printed a Latin version of the Koran, which involved him in a short jail sentence. Possibly his academic training made Oporinus appreciate the importance of Vesalius' book.

The style chosen by Vesalius for the text was classical Latin. This has certain limitations, especially in the range of descriptive words. The only previous work in classical Latin was that of Celsus. This was in line with his classical and humanist upbringing. He would have regarded classical Latin as the only true vehicle for respectable scientific work. He also
An initial from a chapter-heading from the "De Fabrica". This illustrates a grave-robbing scene.

An initial from a chapter-heading illustrates boiling bones prior to preserving them for demonstration.
The De Fabrica - The Text.

The magnificent frontispiece is not without a pedagogical purpose. Vesalius is shown actually doing the dissection, thus attacking by implication the traditional method of teaching. The

Vesalius left Padua in the summer of 1542 to supervise the printing of the book. There is no record of his reaching Basel until January 1543. He did not immediately give up his post in Padua, and Realdo Colombo was appointed to the chair of anatomy and surgery as a substitute, being paid 20 florins annually. On his way to Basel Vesalius probably went to Ferrara and met Grambattista Canano (Examen p.71). The latter was in the process of producing a book "Musculorum Humani Corporis Picturata Dissectio". This book was of high standard, especially the illustrations, which were printed from copper plates. Vesalius put Canano off from completing this book when he saw the standard of the De Fabrica. While Vesalius was in Basel he would have been able to correct many of the printing errors. He also dissected a criminal, and this skeleton still exists.

9. The De Fabrica - The Text.

The magnificent frontispiece is not without a pedagogical purpose. Vesalius is shown actually doing the dissection, thus attacking by implication the traditional method of teaching. The
Two skeletons from the "De Fabrica" '43. The lower one is known as the "Hamlet" skeleton.
not even in a dream, had ever examined the uterus of a cow, goat and sheep". (De Fabrica '43, p. 532). "You will see the difference between those muscles and wonder what Galen had in mind when he overthrew the teachings of other anatomists (the Alexandrians) who taught the parts of the human body otherwise than he observed them in his apes" (De Fabrica '43, p. 185).

In the preface he goes on to outline the structure of the book and remarks that the illustrations are included so that people will understand where language fails or where bodies are unavailable; but he does not regard this as a substitute for dissection.

The first Book is on the bones. Though these are the last structures reached in dissection Vesalius thought that for pedagogical reasons they were the most important: they were the structures upon which the rest hung. As elsewhere, he takes the opportunity of agreeing with Galen where possible. On the other hand he emphasised where Galen went wrong. For example Galen states that there are premaxillary sutures in man. Vesalius shows a diagram comparing a dog's skull with that of a man, the premaxillary suture being in that of the former. Ironically, his picture of the human skull contains the error of showing the ethmoid as a distinct bone. He also disputes Galen's statement that the mandible is two separate bones, though adding in the "Epitome" that this is so in children. Vesalius' difficulties with Galenic physiology are well illustrated in this book. Galen maintains that excretions of the pituita take
Muscle-Men from the "De Fabrica".

Note how trapezius looks like a Benedictin's cowl; a metaphor used by Vesalius.
place through the anterior part of the sphenoid. Vesalius points out that the plate is not perforated and suggests that the secretions pass through the orbital fissure and via the lachrymal canal into the nose. Thus he maintains Galen's physiology but keeps his anatomical integrity, by suggesting this highly unlikely route (De Fabrica '43 p. 49-51). The other great bone of contention in this book was the movements at the atlanto-occipital joint, Vesalius coming to conclusions different from those of Galen after studying the joints and ligaments. He also points out that Galen's description of the sacrum, as being made up of three bones, was wrong and said himself that it was six, selecting the less common variant for his description. Vesalius described the dog's hyoid as that of the human, thus repeating the type of error that he accused Galen of.

The second book is not so successful. The six muscle-men are superb illustrations (see opp.), but the book itself contains many errors. His classification of muscles according to position was not very successful. Later, the classification put forward by Sylvius was accepted. Vesalius suggests that the orbiculo-occulis is involved in opening the eye; a mistake that Fallopio later corrected. The insertion of the rectus muscle into the upper ribs in the muscle-man illustration was probably put in for teaching purposes. The text gives the correct insertion. (De Fabrica '43, p. 282).

Book three, about the arteries and veins, is a mixture of errors and adjustments. He maintains, as he did against Corttius, that
veins have three muscle coats. But he states correctly that the haemorroidal veins are not part of the portal system. Finally, his description of the larger veins and arteries is of simian origin. The picture of the arterial-man shows the carotids and right subclavian all arising from a common trunk from the ascending aorta. (see opp. p. 80)

Book four is on the nerves. He starts off by defining nerves as structures arising from the brain or spinal cord and thus excludes ligaments, tendons and aponeuroses - structures that were sometimes confused with nerves. His description of cranial nerves rested on that of Galen who identified only seven. However, this description, as well as that of the peripheral nerves, was good for that time and was not bettered for a generation.

Book five is on the abdominal viscera and generative organs. Vesalius correctly and antigalenically locates the appendix and points out that the liver does not have five lobes. The spleen is included in this book though Vesalius admits that he does not know its function. Vesalius bases his description of the kidney on that of the dog; this he admits in the text. Some critics who had not read the text accused him of trying to pass off the dog kidney as human. In his description of the uterus Vesalius denies the medieval description of seven lobes and also Galen's suggestion of two horns. On the other hand he missed the two tubes that were later described by Fallopio. (but see p. 64). His description of the foetal
The Arterial Man.

'De Fabrica '43'

Sketch of the Aorta and larger branches. The trunk marked 'D' is simian in form. This is probably by Vesalius himself.
contained the most spectacular mistakes in the 1543 edition. He admits that he had little material for dissection, but this portion was considerably amended in the 1555 edition.

Book VI is devoted to various glands in the upper respiratory tract, lungs and heart. His description of the cervical lymph glands is accurate. Vesalius, like his contemporaries, regarded the lungs as one separate organ; he missed the third lobe in the right lung and therefore states that the lungs have four lobes.

Like his contemporaries, Vesalius considered that the right auricle was a continuation of the venacavas and the left of the pulmonary veins. This appearance of being single continuous veins is greater in the apes and in still-born children than in adult humans. To Vesalius, therefore, the heart was a two-chambered organ. He noted that all sides of the ventricles were equally trabeculated and states, "none of the pits, at least insofar as can be ascertained by the senses, penetrates from the right ventricle to the left. Thus we are compelled to astonishment at the industry of the Creator who compels the blood to sweat through from the right ventricle into the left through passages which escape our sight". (De Fabrica 1543, p. 589).

His description of the heart-valves is good, and while discussing the heart, he takes the opportunity to criticise some
contemporaries who believed that the heart was the seat of the soul. "Lest I come into collision with some scandalmonger or some sort of censor of heresy, I shall wholly abstain from consideration of the divisions of the soul and their location, since today you will find a great many censors of our holy and true religion. If they hear someone murmur about the opinions of Plato, Aristotle or their interpreters, or of Galen, regarding the soul, even in the conduct of anatomy where these matters especially should be examined, immediately they judge him as suspect in his faith and somewhat doubtful regarding the immortality of the soul". (De Fabrica 1543, p. 594).

Book VII is devoted to the brain. Perhaps because it was considered the seat of the intellect, it was a field in which there had been more speculation and less dissection than most. "Who, immortal God, will not be amused at that crowd of philosophers and, let me add, theologians of today, who, detracting so foolishly from the divine and wholly admirable contrivance of the human brain, frivolously, like Prometheus and with great impiety towards the Creator, fabricate some sort of brain from their dreams". (De Fabrica 1543, p. 623 - 624).

At this stage of his career Vesalius rejected the existence of the rete mirabile in humans. Again, to appease current ideas in physiology, he suggested that the vital spirit was gradually distilled into animal spirit along the arteries and was mixed with air entering via the cribiform plate. Like his contemporaries
Vesalius thought that the seat of the intellect was in the ventricles. On the other hand he objected to localisation of functions such as judgement and cognition; he also rejected the idea that nerves were hollow at a macroscopic level.

The exact date of publication of the Epitome is uncertain. It was meant for medical students and people with no prior knowledge of anatomy. The emphasis was on the illustrations, and the medieval and Arabic nomenclature was omitted for the sake of clarity. The text was called a summary of the De Fabrica, but is really only a series of selections. Probably because of its greater simplicity, brevity and lower cost, it was of greater popularity, though less significant than the De Fabrica. A few days after the Latin production, a German translation was published by Albanius Torinius, Rector of the University of Basel. Vesalius' woodcuts were used and Oporinus was the printer, so it can be assumed that this production was done with the knowledge and consent of Vesalius. In the same year Copernicus published his "De Revolutionibus".

10. Imperial Service 1543 - 1549.

As soon as the books were printed, Vesalius presented a copy of each of them to the Emperor Charles V. He was enrolled in the Emperor's service as "medicus familiaris ordinarius".
The reason for his accepting this post is unclear. Vesalius knew that the post was one from which he could not resign. He also knew that it would allow him no time for research. On the other hand he regarded anatomy as a training for the practice of medicine and surgery, and he may have considered that becoming a physician was the logical conclusion of his anatomical training, possibly with the example of Nicola Massa before him. The fact that he was coming under considerable attack for his antigalenical views, may have persuaded him to seek a secure position. That he was upset by these attacks is substantiated in a letter of his (printed Basel 1546) where he remarks that he burned a number of unpublished books. On these grounds and on a short passage in the De Fabrica (1555, p. 511) it has been suggested that Vesalius suffered from a peptic ulcer! (Bull. Hist. Med. 32 75). Finally, the last factor that may have influenced him in his decision was the family tradition of medical care in the imperial service. In any case, this decision brought to an end Vesalius' active research work. His future influence on anatomy was only in the realm of defence of his published work. The Emperor was by no means an easy patient. He exhibited symptoms due to inbreeding of the Hapsburgs. The prominent Hapsburg jaw caused him to mumble. On his mother's side there was a history of insanity and the Emperor showed an unbalanced nature. He was asthmatic, a glutton of gargantuan proportions, he suffered from gout and, finally, he seems to have been particularly disinclined to take the advice of his physicians or confessor on matters relating to
his health, but would seize on the advice of any quack who promised health without dietary restraints. There were two physicians who had at least nominal precedence over Vesalius, Narcusso Vertunno and Cornelius van Baersdorp. Only the latter was actively engaged at the court.

After serving as a surgeon in the imperial army in 1543, where his treatment of gunshot wounds was certainly no better than his contemporaries and worse than that of Parrés, Vesalius departed for Italy. When he reached Padua he found Colombo, his previous pupil and friend, belittling his reputation. Probably Colombo never expected to see Vesalius again. However, the attack was not directed at Vesalius' antigalenic position but rather because he had missed certain structures. After performing a very popular dissection in Padua (approximately 500 students attended) Vesalius passed on to Bologna where he stayed with his old friend, Bianchi. During his visit he was asked to carry out a public dissection. This he did, dissecting out the venous system. However, much to the annoyance of the spectators, he did not complete it but departed on the next day for Pisa. Possibly this was because he did not relish the long controversy that was obviously in the offing on Galenic and Aristotelian physiology of the heart. In the preface of the "De Fabrica" Vesalius remarks "Days are wasted in ridiculous questions so that in such confusion less is presented to the spectators than a butcher in a stall could teach a physician".
Vesalius reached Pisa on January 20th 1544, where he lectured and dissected. In a letter (China Root) he remarks that there was difficulty in obtaining material and proceeds to give advice on how to obtain bodies and bones from cemeteries. He apparently enjoyed much success and was offered a post at 800 florins a year, a huge income for such a post. The Emperor refused permission for Vesalius to leave his service. Later Colombo got the position at a lower rate of pay. In the spring Vesalius returned north and married Anne van Hume. In July 1545 a daughter, Anne, was born.

The rest of the year was taken up with various military campaigns. Initially Dara Chaca (Cirurgia I, p.261) remarks that Vesalius was not very good at surgery, but by 1545 his technique had improved and he performed the first recorded operation on a case of osteomyelitis. (D. Chacon, Cirurgia p. 69).

In January 1545, after concluding a peace treaty with the French, the Emperor returned to Brussels. Due to dietary indiscretions the Emperor went down with a severe bout of gout and was treated with the China Root (Bull Med. Libr. Assoc. 1945 33 231-253). Probably the success of the treatment was due to the strict dietary regime that was instituted at the time of taking the drug. During the next two years, in between travels, the Emperor went down three times with gout and, no doubt, was attended by his physicians.
In 1546 the Emperor was in Ratisbon. While there Francesco d'Este of Ferrara fell ill. Càmbattista Canano was sent to treat the patient and Vesalius was also consulted, so the two friends met again. Vesalius wrote of this "When I visited the ailing Francesco d'Este with Canano at Ratisbon, the latter told me that, at the commencement of the azygos vein, as well as at the orifice of the veins entering the kidney and of the area at the upper end of the sacrum, he had observed membranes similar to those occurring at the origin of the pulmonary artery and aorta, and he asserted that they prevented the reflux of blood" (Examen p. 83). So near but so far from the idea of the circulation!

When Vesalius arrived at Ratisbon he received a letter from a doctor, Joachim Roelants. Vesalius apparently had known Roelants well and had sent a letter of introduction for his son to Sylvius. At the same time he invited Sylvius to comment on his "De Fabrica" and Sylvius had replied in an uncomplimentary manner. Vesalius' reply to Roelant's letter dealt with the controversy with Sylvius and also the China Root. The letter fell into the hands of Vesalius' brother Franciscus, who arranged to have it published. In the foreword Franciscus pleads with his brother not to be upset. It seems that Andreas got to know of this and co-operated in the venture, to the extent of making corrections. It was published in October 1546. With respect to the China Root Vesalius is uncertain of its effectiveness, partly because the Emperor did not keep to the dietary regime. With respect to the controversy over the "De Fabrica"
Vesalius starts off by attacking those physicians that are good "only for providing syrups and laxatives". He then mentions that he has set the example in taking a critical approach to the ancient authorities and that people should seize the chance of discovering new truths. Vesalius next passes on to Sylvius explicitly. (He had condemned Vesalius for correcting Galen and further threatened Vesalius with an all-out attack from himself and his students in Paris.) Sylvius suggests that Vesalius had been perverted by the Italian schools.) Vesalius reiterates some of the more obvious Galenic errors and asks Sylvius to try out his empirical method. He then concludes the letter by mentioning various plagiarisms of the "De Fabrica". (See p.Ω7Ω).

The next two years were spent campaigning with the Emperor against the Protestant League of States, and also treating bouts of gout from which the Emperor suffered. In 1547 Vesalius was in Basel. Possibly at this time a further edition of the De Fabrica was discussed with Oporinus, though the latter states in a letter (Gesnerus 1945 2 207-212) that the 1543 edition was not yet sold out. In 1549 Philip, the heir of Charles, came to the Netherlands and was taken on a tour by his Father. This was the first time that Vesalius met his future master. In the same year there appeared a new edition of Beneditti's work published by Professor Marcus Hopper of Basel. The dedication opened with "To that very famous and learned man Andreas Vesalius", indicating the growing prestige of the former professor of Padua.
11. The Controversy with Sylvius.

This same year saw the publication of Sylvius' translation of Galen's "On the Bones" for the printer Balamio. It was accompanied by a commentary in which Sylvius sought to defend Galen against the criticisms leveled in the De Fabrica. This was the first public writing by Sylvius against Vesalius. The author does not refer directly to Vesalius but to "Vaesanus", the Latin for a madman. It was quite obvious who Sylvius was referring to. The introduction finishes with: "If there is anyone of calumnious nature who refuses to believe what he has heard or one who refuses to accept either Galen's word or Sylvius' commentary, then let him in his scorn come to Sylvius' home, where he might see and touch those things discussed, since there is greater faith in sight than in learning, and most of all in touch". Thus, in the middle of his attack, Sylvius is forced to appeal to the empirical standards that Vesalius had introduced. Sylvius was inclined to see the things he wished to see; on page 42 he says the sacrum is composed of three bones with the coccyx as the fourth. On the other hand he says "The sternum seen by Galen was composed of seven pieces and this readily explained by the different structure of men in those days." (Page 47). Further he suggests that the text which stated that the humerus was larger than the tibia was defective (Page 52). In this way Sylvius in fact concedes many points without, however, admitting that Galen was wrong and, of course, not allowing that his direct knowledge of anatomy was restricted to dissection of apes.
In 1551 the Professor of Surgery at Tübingen, L. Fuchs, wrote a book "De Humani Corporis ex Galeni et Andrea Vesalii Libris Concinnate Epitome". This contains a eulogy of Vesalius; Galen is quoted with respect but not enthusiasm. This year saw the appearance of Sylvius' "A Reflection of the Slanders of a Madman (Vaesanus) against Hippocrates and Galen". As an example of its contents: "I have heard that a certain mad deserter, wholly arrogant and wholly ignorant, was most iniquitously uttering the vainest slanders against their physiology." However Sylvius must have realised that he was fighting a losing battle for he says (Fol. 9n): "There is today a very large group of physicians in France, Italy and Germany, who, despite lack of anatomical skill, give their approval to all writings of the slanderer and support them strenuously". He also notes "After I had completed this work, behold, Fuchs published an anatomical epitome containing misrepresentations selected from that vast and worthless farrago of nonsense".

A student, Renatus Henerius, who was later to write in defence of Vesalius and was studying in Paris under Sylvius, wrote of him: "When I was in Paris three years ago Sylvius published that tragic, very abusive and virulent attack on Vesalius.....Many of us had great hopes that he (Sylvius) would make a survey of the field of anatomy, a thing that he had long promised his students. We awaited this in great eagerness, never doubting that in time he would fulfill his promises", He later states that the students became wearied with the streams of abuse against Vesalius. The writings of Fuchs
goaded Sylvius, but the latter's abuse did not deter Fuchs from bringing out the second volume of his Epitome.

In 1557 when Henerius' defence (Adversus Jacobi Sylvii demulsionem anatomicarum calumnias pro andreas Vesali) came out, he states that Galen would, himself have objected to being considered an infallible authority; secondly, that it would be foolish to deny Galen's own word that he dissected only animals; and, thirdly, that Sylvius had created a false condition of conservative obstruction at Paris which compared unfavourably with that of Rondelet at Montpellier. In this same year Sylvius published "Isagoge". He died soon after without further contribution to the controversy.

12. Vesalius 1549 - 1556.

Between the years 1549 and 1552 the Emperor continued to lead an active life and Vesalius accompanied him on his travels. However, from 1552 to 1555 ill-health seems to have gained the upper hand with the Emperor, and he remained in Brussels for this time. Cardinal Granvelle (Papier d'Etat du Cardinale Granville VIII, p. 525) estimates that Vesalius' income was over 5000 livres, with 30,000 livres as capital. Vesalius was very well off and was approaching the height of his fame as the foremost physician in Europe. In 1556 the Emperor made Vesalius a Count of Palatine - which does not seem to have impressed him very much - and immediately prior to his abdication, the Emperor pensioned Vesalius off.
Later, he was taken on by the new King of Spain, Philip. In August 1556 Philip departed for Spain and Vesalius went with him in the capacity of physician to the Netherlanders in the court. This position was chosen owing to nationalistic hostility on the part of the Spaniards. The reason for this departure was a combined attack on Spain by the King of France and the Pope. However, the Spanish quickly gained the upper hand and a peace treaty was signed in April 1557.

13. 1555. The Revised De Fabrica.

The advantages of a new edition of the De Fabrica must have quickly become apparent to Vesalius. For example, he could not long have been satisfied with his sections on embryology. Oporinus also seemed to be in favour of a new edition. On the other hand, he still had unsold copies in 1547, and as each copy cost five florins, he must have kept a careful eye on the economic factor at stake. The cost of the De Fabrica, together with its size, must have deterred many potential students from buying it, and would have encouraged the popularity of plagiarisms.

When he entered imperial service Vesalius' interest in anatomy did not cease. He carried out autopsies and refers to examining the entrails of the Prince of Orange prior to the body being embalmed. When accompanying Charles on his flight from Innsbruck, he took time off to study skulls from a graveyard in Styria.
The first five books of the De Fabrica were probably revised during Vesalius' protracted stay at Augsburg from August 1550 to October 1551. These books were advertised for sale in a catalogue issued by Oporinus in May 1552 (Roth p. 224). However, no copies have appeared for this year, so it is possible that Vesalius or Oporinus decided to wait.

Except for the title page, which depicts the same scene as the 1543 edition, but is artistically inferior, the prints were the same. Stylistically the De Fabrica was revised, but Vesalius retained the Ciceronian mode of writing, even though this must have been unfamiliar to many of his readers. The illuminated chapter-headings were changed, but the same theme of putti involved in anatomical scenes was kept (see examples from two editions opposite p.414). The text itself was re-arranged to make reference to the illustrations easier and, secondly, the text was spread out over the page rather more than in the 1543 edition, thus allowing easier reading.

A number of changes was made in the contents. The names of people who had either died or fallen into Vesalius' bad books were omitted. Thus Sylvius is not mentioned by name, though the following quotation probably refers to him: "Calumnius and utterly false disparagements of certain malicious old men". The chapter on embryology was completely revised, and contains comparisons of human, cow and dog placentas. In Book II, chapter XV, Vesalius declares himself dissatisfied with Galen's
physiology, and that movement of blood across the intraventricular septum is unlikely; he was unable to find any pores when probing with a pig's bristle. He drew attention to Canano's discovery of valves in the veins.

Probably the Epitome was re-issued unchanged except for the title page. A copy dated 1555 exists in the Walter collection in Upsala.

Thus, the new De Fabrica did not contain many anatomical advances. On the other hand, there are no retractions and the lay-out of the book is improved, so facilitating study. The appearance of this edition in this form indicates the success that the previous edition enjoyed.


Vesalius was called to Paris to treat Henry II following his injury in the Joust against Count Montgomery. Paris was also present. After seeing the patient Vesalius' prognosis was poor, but his description of cerebral compression following subdural haemorrhage and contra-coup injury is extremely good.

As was stated earlier, Vesalius departed for Spain on August 23rd, 1556, and for the next five years pursued an uneventful career as a physician.

In 1561 he received a copy of Fallopio's "Observationes
Anatomy

Fallopio (1523? - 1562) had followed Colombo as Professor of Anatomy and Surgery at Padua, after being Professor at Pisa, and was, therefore, directly in the academic tradition of Vesalius. Fallopio was a native of Modena and Ferrara. It is unknown where he studied or where he received his doctorate. He did spend a year in Padua whilst Vesalius was there; however, it seems that Fallopio and Vesalius never met, though they had a mutual friend in Canano.

Vesalius received his book in the summer of 1561, but his reply is dated December of that year. The book was a mixture of praise and correction of Vesalius' work, and was not an inclusive textbook. Thus, he writes that Vesalius was a "glutton for Galen, but he was not deterred by Galen's authority from adding to the art anything his preceptor had overlooked (Fol. 42). He identified the round and oval window of the middle ear; he corrected Vesalius' contention that the sagittal sinus passed through the occipital bone; he described the levator palpebrae for the first time, as also the Fallopian tube. (On the other hand, Vesalius describes (F. 1555, p. 659) a female semen-carrying tube - a fairly exact description of the Fallopian tube).

Fallopio denied the existence of three muscle coats to the veins, which Vesalius finally accepted, but denied the existence of valves in veins.
The book displayed originality, careful investigation and considerable restraint in its criticisms. Vesalius wrote highly of the book in his reply, the "Examen". On pages 1 - 2 he writes: "I feel that the elaboration of our art has come from that arena from which, as a young man, I was diverted to the mechanical practice of medicine, to numerous wars and constant travel". Vesalius seems to be expressing regret at giving up his academic career. As the standard of medicine was low in Spain and the opportunities for dissection poor, Vesalius' criticisms tend to rest on the authoritative texts. He, however, takes exception to Fallopio's praise of Valverde for the discovery of palmaris brevis.

Valverde had plagiarised the De Fabrica and criticised Vesalius in his books. Vesalius responded: "Valverde, who has never put his hand to dissection and is ignorant of medicine as well as the primary discipline....... I would that you grant nothing to his authority, since you are far above the common school".

In 1562 the son of Philip II, Don Carlos, fell whilst running after a girl, and injured his head. Vesalius was called in for his opinion and the Prince finally recovered. The credit for the cure seems to have been given to the flagellants and the Masses which were offered for the Prince's health.

In 1564 Vesalius received permission to depart on a pilgrimage to Jerusalem. One suggested reason for this is that the In-
quisition required the pilgrimage following an accusation of human vivisection, but this has been denied (Lanc. II 1929, p. 369). It seems more likely that he left under pressure from the conservative medical circles in Spain, or that it was a device on Vesalius' part to get away from Spain. He first went to Venice and probably made inquiries about obtaining an academic post in Padua. The chair occupied by Fallopio had been open since his death in 1562.

Vesalius reached Jerusalem without incident. On the return trip it seems that the ship in which he was sailing was delayed, and the passengers suffered from exposure. Finally, they reached Zante, where he apparently caught an infection, possibly the plague, from which he died. A Venetian goldsmith arrived on the island in time to bury him.

Thus died, at the early age of 50, one of the most influential figures in European science.

PART III
His Impact on His Contemporaries and Later Anatomists.

1. Summary of his Contribution.

We have seen that most of Vesalius' contributions were pre-figured in earlier works, but he was the first to bring them all together.
a) His first contribution was his empirical approach to anatomy. Where he saw something different from that which the ancients taught, he did not fail to point it out.

b) He was able to give telling reasons why many of these mistakes had occurred, e.g. Galen had dissected animals only. In this way he stimulated interest in comparative anatomy. This point in particular upset his antagonists, but they were unable to refute him.

c) He limited his discussions to anatomy and did not sidetrack on to philosophical issues. He thus centred the controversy on anatomy.

d) He encouraged dissection and practised dissection himself. He was thereby able to demonstrate directly to his students previous anatomical errors. The only alternative for his students was not to believe their own eyes.

e) His diagrams in the Epitome and De Fabrica were an advance on anything previous to his work. Where he was not able to dissect himself, his diagrams were used as an aid to dissection. Their popularity is evidenced by the numerous plagiarisms.

f) In the De Fabrica he carefully enumerated his dissection procedures so that students could check his assertions. On the other hand, he was aware of the existence of anomalies and warned of their misleading nature.

g) Vesalius was probably aware of the propaganda value of his pictures as opposed to his text. This was his reason
for being annoyed at the low standard of some of the plagiarisms.

Finally, the field in which he excelled and where he was most critical was osteology. Bones were probably the most easily available of anatomical material, i.e. from graveyards, so students were easily able to check his assertions.

2. The Occupants of the Chair of Anatomy at Padua.

Colombo's father had been professor at Padua previous to Vesalius' tenure of the post. Colombo had been taught by Vesalius, and during 1541 it was suggested that he should be a lecturer in anatomy. This, however, was turned down and he succeeded to the chair in 1544. Later in 1544 he departed for Pisa and probably it was at Pisa that he taught Valverde. In 1548 he departed for Rome where he started writing his book "De Re Anatomica" with Michelangelo as the artist. Later he entered papal service and finally died in 1559. His plan for illustrations evidently came to naught, as the book contains none. In this respect it is considerably inferior to the De Fabrica as a pedagogical work.

However, he continued the empirical approach started by Vesalius. His description of the eye, in particular the lens, was an improvement on Vesalius, as was the description of the
peritoneum and pleura. Colombo is chiefly remembered for his discovery of the pulmonary circulation. He entirely rejects transseptal flow, demonstrates that there is no air in the pulmonary vessels and understands the function of the valves of the heart. It was from this that he deduced the pulmonary circulation.

Colombo himself seems to have been a rather unpleasant person. He accuses Vesalius of fraud, i.e. of drawing the larynx of a dog and passing this off as human. This is manifestly untrue - Vesalius explicitly mentions that he had used dogs.

Fallonio (1523 - 1562) was another pupil of Vesalius at Padua. He succeeded Colombo as a teacher there. We have already seen (p.64) that he was an extremely competent anatomist, and that he followed in the steps of Vesalius. His book, judging from the remarks of Vesalius in his "Examen", met with his approval. Fallonio's book was not an all-inclusive textbook and as such was not very popular. He had wide influence through two of his pupils, Goiter and Fabricus.

Fallonio succeeded Fabricus in the chair of anatomy at Padua, which he held until 1604 when he retired at his own request. Fabricus excelled in the field of embryology following the work of Coiter. As well as describing the development of the chick, there is a very good comparative study of the embryo in the more
advanced state in a number of species. ("On the Formed Foetus"). He also draws attention to the changes in the vascular system at birth. Perhaps his best known work is that "On the Valves of the Veins". This had a great influence on Harvey, who borrowed the illustrations for his book "De Mortu Cordis et Sanquinis". Harvey studied at Padua under Fabricius and was clearly very much influenced by his teaching. He maintained the strong Paduan Aristotelean bias to the end of his life.

Following Fabricius in the Chair of Anatomy at Padua was Gulio Cassiero, a pupil of Fabricius. He excelled in the field of comparative anatomy, particularly that of the sense organs. He first gives a careful description of the human organ and then follows it through a series of animal forms. His illustrations using copper plates were of a high standard.

On the death of Cassiero in 1616 he was succeeded by Adriaan van der Spieghel. His anatomical works were not published until after his death in 1625. His books contained many refinements on previous anatomical descriptions, particularly the muscles of the back. His terminology for muscles was a great advance and was original work. It was with Cassiero that the line of great anatomists at Padua came to an end. As has been shown, they were pupils by descent of Vesalius, and maintained his empirical approach, expanded his tentative comparative anatomy, and revolutionised embryology. Above all, they continued and, if
anything, improved his pedagogical techniques, in particular in
the standard of their books. Fallopianus used some coloured illus-
trations in his books.

3. Influential Anatomists Who Were Trained at Padua.

Valverde did not, himself, train at Padua, but at Pisa. The professor at Pisa was Realdo Colombo (1545). The pupil of Vesalius, he also seems to have studied in Rome under Eustachio. In 1556 he brought out his book "Historia de la Composicion del Cuerpo Humano" in Rome. This book was very popular. It appeared in almost a dozen editions in four different languages: Spanish (first edition), Italian, Latin and Dutch. The text of this work is an extensive plagiarism of the De Fabrica, though he picked out a number of errors and took pains to call attention to them in the text. In fact, his original contribution to anatomy is very minor. The illustrations in the book are good; ninety-five percent originate from the De Fabrica and have undergone but minor changes. (Bul.Inst.Hist.Med. 14, p. 685). Possibly the great popularity of this work was due to its appearing in the vernacular, also that it was half the size of the De Fabrica and consequently cost less, and that the diagrams taken from the De Fabrica, though rather bizarre, were of a high standard.

Montana was another influential anatomist in Spain. He
also wrote in the vernacular and plagiarised Vesalius' illustrations. Perhaps it was significant that Vesalius' "Epitome" appeared in German and Valverde's work was not produced in this language. Valverde's book was translated into modern Greek in the seventeenth century.

Another pupil in the line of Vesalius was Volcher Coiter, who studied under Fallopius and also under Arantius at Bologna, under Eustachius at Rome, and under Rondelet at Montpellier. He finally settled in Nuremberg, Germany, where he published his books. Coiter gives a fine account of the embryological development of the chick. He is truly the father of embryology, for this work was the first on embryology, with the exception of a few remarks on this subject by Albertus Magnus, since Aristotle. He also did work in comparative anatomy; he was the first to describe, with the exception of Leonardo, the frontal sinuses. His best work in comparative anatomy was a systematic description of the skeletons of a large number of animals. He advised anatomists to read nothing but Galen, Vesalius and Fallopius.

The Paduan tradition in anatomy was carried to the north by various pupils. Bauchin, a pupil of Fallopio, became professor at Basel, where he erected an anatomical theatre, as well as writing on botany. Peter Paauw, also a pupil of Fabricus and, like Bauchin, professor of anatomy and botany, built an anatomical theatre at Leyden. He published an anno-
tated version of Vesalius' works. Perhaps it is fitting that a student of Padua should have worked at the University which was to become the most important centre of anatomical studies in Europe late in the 17th century, and was to furnish part of the training of Alexander Munro, who occupied the chair of anatomy in Edinburgh. A Dane, Claus Wormius, studied under Fabricius at Padua and Bauchen at Basel. He practised in London and settled in Copenhagen. Another pupil of note of Fabricius was Caspar Bartholi, father of Thomas Bartholin, the discoverer of Bartholin's gland. Paris was to remain relatively uninfluenced by the pupils of Padua. Riolan was appointed to the chair of anatomy early in the 17th century. We have seen how the students re-acted to Sylvius (see p. 59). However, during the later part of the 16th century Paris became a humanist centre and produced some fine medical dictionaries, especially that of Brussavola on Galen.

Thus, we can see how the influence of Vesalius spread from Northern Italy to Spain, Germany, Holland, England, Denmark and Greece.

4. The Pirated Editions of Vesalius' Works.

In 1545 Thomas Geminius, an Italian émigré, pirated Vesalius' figures of women and used them in a text on midwifery produced in London. The text was in English and was written by Thomas Reynold. In the same year he brought out the "Epitome". Accom-
panying the illustrations was an English rendering of the captions in the De Fabrica, the rest of the "Epitome" was left in Latin. Later, the illustrations were used again, but the text, entirely in English and probably translated by Thomas Vicary, was taken from the medieval anatomist de Mondeville. Despite the remarks of Vesalius, who probably never saw the prints, the illustrations were of a high standard. They are the first examples of prints from copper etchings in England. These prints were obviously very popular, as new editions appeared in 1552 and 1559. The same plates were also used by Wechel in Paris in 1564, 1565 and 1569. It is difficult to assess the importance of the illustrations without the full text of the De Fabrica. It appears that in England, Scotland anatomy remained predominantly Galenist and medieval until well into the 17th century. Vicary brought out a book on anatomy in 1578 based on de Mondeville, in English. It continued to be re-issued until 1651. On the other hand, John Bannister published a rather pretentious book late in the 16th century which relied very heavily on Realdo Colombo. In 1615 Hezekiah Crook published an anatomical work in English which, he admitted, relied heavily on Valverde and Vesalius.

In 1552 Jean de Tournes of Lyons published a pocket version of the De Fabrica; it contained no illustrations and does not seem to have been very successful. The plagiarisms of the "Epitome" by Leonhart Fuchs of Tübingen (1551) and also of Jan
Valverde (1556) have already been referred to. Valverde's work was also reprinted in 1559 (Italian) and in 1566 and 1568 (Amsterdam in Dutch). Two more editions of the De Fabrica were brought out after Vesalius' death in Venice (1568 and 1604). Both editions were identical. Unfortunately, the frontispiece was changed and a rather inferior plate, looking vaguely like a triumphal gate decorated with anatomical carvings, was substituted. Thus, it can be seen from the number of new editions, plagiarisations and piratings of this great work, that Vesalius was, in the main, widely accepted and extremely popular throughout Europe.

We have already seen (p. 58) that the first attack mounted by the Galenists against Vesalius was overcome. The only other attack of note from this quarter was that of P. Puteus in his "Anatome pro Galeno contra Andra Vesalii". This attack is interesting in that, though the author admits he has not himself done any dissection, he appeals to the students to verify the truth of Galen by dissection. "Do not omit, students, to practise dissection very diligently. Do not admit either Galen or Vesalius, but look for yourselves and you will be convinced". Thus, Vesalius' empirical method had breached even the stronghold of Galenism. It is suggested that Puteus was encouraged to write this by Antonio Fossana, a physician of strong Galenist leanings in the court of Charles V and Phillip II.
Cuneus, a professor of Pavia (1554 - 74), had been cited by Puteus as an authority who would support the author in this attack. However, he had been misinformed. Cuneus wrote in 1564: "Examen of Puteus' attack on Andreas Vesalius", in which he states: "For although we are under the greatest obligation to Galen, the common preceptor of all, still it does not behove us to have such devotion to him that we must submit to him rather than to the truth".

5. England and Scotland.

We have already noted that in 1554 the "Epitome" was published in England, and later that Vesalius' figures were used to illustrate various medieval texts. It seems that England remained predominantly Galenist in outlook until the time of Harvey. It is tempting to think that this is due to the absence of Vesalius' text of the De Fabrica in this country. Another factor of importance is that, compared with the Continent, the surgeons in England were illiterate.

I have been unable to trace any work of Vesalius in Scotland before the Reformation. Two books on medicine, one by Valverde and the other by Estienne, were in Aberdeen University. The College of Surgeons in Edinburgh did not have a permanent hall at that time and, hence, no permanent library.
The only other possible impact of Vesalius' ideas on Scotland was from surgeons who travelled in Europe, such as James Borthwick, and then returned to Scotland. Cardano (died 1574) came to Scotland and he certainly knew of Vesalius. However, there is no doubt that both Scotland and England were well behind the rest of Europe at this time. D. Liddel was active in Aberdeen at the turn of the 16th century.

6. Conclusion.

In conclusion we have seen how the school of Padua continued in the tradition started by Vesalius. Further, we have seen how pupils trained at this school spread throughout Europe. Finally, we have tried to indicate how Vesalius' ideas spread in Europe by briefly describing the various places in which Vesalius' works were either plagiarised or pirated.
Bibliography.

10. The Development of Scientific Method in the School of Padua.
    J. H. Randall.

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