

CONTINGENCY AND LOGIC IN RENAISSANCE
ANATOMY AND PHYSIOLOGY

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by

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ABSTRACT

Anatomy in the sixteenth century presented nearly all the signs of a young and vigorous science. Its practitioners found themselves equally in demand from University senates and students. The programme of the new anatomy was extensive. Anatomists claimed that they were re-drawing the picture of the human body, that the mistakes of the Greeks would be blotted out and that the fabric of man's body would be delineated not from apes and dogs but from man himself. Only one thing was missing: there were no new ideas of how man's body worked. Re-adjustments to Galenic physiology were made, it is true, but these were usually derived from the alternatives already available from the writings of the ancients. The first new science of the renaissance was crippled because, until the time of Harvey, it did not extend its belief in the possibility of producing a new picture of man to that of creating new ideas and theories.

In the first part of this thesis the sterile and derivative approach of the anatomists to questions of physiology is traced out in two case examples, that of the spleen and black bile and that of the rete mirabile and the animal spirits. In the second part of the thesis I show that there existed within the medical establishment an articulated view of knowledge which denied the possibility of deriving new physiological theories from discoveries in anatomy, or indeed, of producing any original a priori ideas at all in medicine

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INTRODUCTION

This research begun to take shape when I read Adrianus Spigelius's refutation of Galen's assertion that the spleen was a container of melancholy. After examining the work of other sixteenth century anatomists it seemed to me that the problem of the spleen in the sixteenth century could be seen as an example of a paradigm in the Kuhnian sense. When, however, as a result of further reflection I became convinced that it was impossible to write history in terms of philosophical paraphernalia such as 'competing research programmes', 'paradigms', 'degenerating research programmes' and the like, I determined to discover the conception of knowledge held by medical writers of the sixteenth century through their own writings and not from some arbitrary model of science conceived in the present century and nurtured by the contentious squabbles of philosophers.

I was fortunate in that I found a body of work in which the status of medical knowledge was explicitly discussed. The ideas of renaissance writers on the philosophy of medicine mirrored the view of knowledge which, from my analysis of contemporary discussions of the spleen and the animal spirits, I believed to be held by the anatomists of the period.

This thesis should give some insight into the question of why in the sixteenth century the basic theories of physiology did not change when there were so many discoveries in

anatomy. It also shows that in the sixteenth century there was current a general feeling that the basic theories and principles of medicine were unalterable. Much more work needs to be done in sixteenth century medicine in its social, intellectual and political aspects before a reasonable picture of it can emerge. My own research may supply a piece of the mosaic.

Where possible I have used contemporary English translations of sixteenth century Latin works, for I believe that they are nearer to the original sense than any modern translation. I have relied as much as possible on primary sources; however the lack of secondary sources in this subject has meant that the problem of deciding whether to choose between primary or secondary sources has not occurred very often. Those I have used are listed in the Bibliography.

CHAPTER I

GALEN ON BLACK BILE AND THE SPLEEN

INTRODUCTION

In this chapter I shall analyse at some length the way in which Galen wrote of black bile and of the spleen's function. By doing this I hope to show the complex interaction in Galen's work between tradition, observational evidence and his own ideas. Not only will this give an understanding of Galen's thought but it will serve to put the work of sixteenth century anatomists into perspective. The rich vein of creativity which is to be found in Galen's establishment of the theory of black bile and of the spleen is practically non-existent in the writings of the renaissance anatomists. It is true that they were to disagree with Galen's ideas on the function of the spleen, but they merely substituted Aristotle's ideas for those of Galen. The great originality of the anatomists of Vesalius's day lay in their desire to make new observations of the human body, but it is my contention that in the field of basic theory their thinking was static and derivative. This chapter on Galen's construction of a theory of black bile (melancholy) and of the spleen should serve to bring out the paucity of original theoretical thought in most sixteenth century anatomists.

The history of melancholy forms an interesting paragraph in the history of European culture. From the time of the Greeks⁽¹⁾ to that of Durer's 'Melancholia I'⁽²⁾ and Burton's 'Anatomy of Melancholy', melancholy has been seen as an element of man's character. This use of the word in the psychological sense can be found in the 'Aristotelian Problems'⁽³⁾ and earlier, in the Hippocratic corpus.

The medical or materialistic sense of melancholy, that is black bile, can be seen in Hippocrates and Plato. Both thought that an excess of black bile caused the psychological state of melancholy as well as producing physical disorders. It was, however, Galen who first placed black bile within a rational and scientific context and showed that it occurred as part of the normal processes of the body.

Properly to understand Galen's views on black bile various subjects must be dealt with, for Galen's doctrine is a mosaic of new and old ideas. An explanation of the functions of black bile and the spleen as given by Galen in his physiological works will serve as necessary background information. Galen's description of the generation of black bile and his attempts to make it seem that the older writings on black bile agree with his own will show the extent of Galen's rationalisation of disparate elements. At the same time the use of a priori argument by Galen to support his theory and his use of evidence from disease symptoms will also illustrate what is new and what is derived from older writers. Finally Galen's adherence to Hippocrates

as opposed to Aristotle will help to explain how his a priori argument should be interpreted and throw light on the nature of the humoral doctrine as a whole.

Apart from the intrinsic interest of Galen's ideas on black bile there is another reason why they are relevant to this thesis. Black bile does not exist nor do its functions. Galen thus lent his authority to the establishment of a physiological fiction that was to exist for centuries. The type of argument used to create a fictional substance will show the relationship between preconceived ideas or hypotheses and observational evidence and also points out the extent of the influence of traditional doctrines. The example of black bile will give us an insight into the balance between hypothesis and observation in Galen and the examination of work of the sixteenth century writers will indicate the extent if any, to which the balance changed in time.

Black bile in Galen's system of digestion.

Galen placed black bile squarely within his overall explanation of digestion. He did not use any special or abnormal terms to describe how black bile was generated; the description is completely rationalised as part of the common explanation of digestion. It is only when one looks at Galen's justification of the existence of black bile, his description of its dual nature and the contrast with previous views that the forced nature of the rationalisation becomes obvious. That, however, is antecedent to the

finished system of digestion in which black bile seems naturally to take its place.

Galen understood digestion in a very wide sense. For him digestion is the way in which the body grows, is nourished and kept in equilibrium, and eliminates waste products. The scheme is set out in the Natural Faculties and, to a lesser extent in the Use of Parts. The role of black bile in digestion is not very great, but it can only be grasped fully when considered within the general context of Galen's system of digestion.

Digestion begins when food is changed in form but not in substance by mastication and mixture with saliva so that it is fit to be received by the stomach. When the food enters the stomach through the cardiac orifice, the pylorus is shut and the stomach itself closes tightly round the food. The stomach then changes the food into chyle by the implanted or innate heat of the surrounding organs and vessels. These are the liver, heart, spleen, arteries and veins.

The stomach absorbs as much chyle as it needs for its nourishment, and the pylorus then opens allowing the chyle to enter the intestines. From there it is absorbed or 'given' ('anadosis') to the mesenteric veins which lead it to the liver. Meanwhile, the worthless part of the ingesta are turned into faeces along the intestines as more and more chyle is taken away by the mesenteric veins. The chyle travels along the mesenteric veins until it reaches the liver. In the liver it is transformed into blood.

The faculty of power of assimilation which Nature gives to the liver is responsible for the changing of chyle to blood. Galen answers the question of how each part and organ of the body grows and is nourished by stating that every part has an inherent power to attract to itself suitable nutriment. A process of digestion occurs whereby the food is changed or assimilated to the nature of the part requiring food. Thus not only is the transformation of food into chyle part of digestion but also that of chyle into blood and, indeed, blood into marrow and marrow into bone. A part of the body may transform more nutriment than it requires and the remainder can serve as suitable nutriment for another part. The stomach does this with chyle and the liver with blood. Galen is careful to state that this is not done with forethought by the part concerned but 'per accidens', the rationality being part of Nature's general artistic design.⁽⁴⁾

Galen considered the liver to be the haematopoietic organ 'par excellence'. He thought that the substance of the liver was congealed blood, the transformation of chyle to the nature of the liver's substance means, therefore, that the chyle becomes blood. In the Use of Parts Galen gave a summary of his view:

"There remains then, as the principal instrument of sanguinification and source of the veins, only the so-called flesh of the liver,

which is certainly the characteristic substance of the viscus. Indeed if one observes carefully the nature of this flesh, it obviously seems very closely akin to blood; for if in imagination you dry out and thicken some blood by warming it, you will find that what you have produced is no different from the flesh of the liver. Its appearance is also in favour of the proposition I have frequently demonstrated in my other works, namely that all the parts which alter nutriment have as their goal, so to speak, and purpose to make what they alter similar to themselves." (5)

The passage of the chyle through the mesenteric veins, which lead to the liver, meant that it was already partly changed to blood, for veins also have this capacity for assimilation. The transformation is made complete in the liver. The many twisting folds and channels of the liver delay the stay of chyle in the organ and enable the complete change into blood to occur. (6)

There are two residues of this assimilation or digestion of chyle into blood. The thin part is yellow bile which is led from the liver to the gall-bladder. It is then excreted into the intestines where, by its bitterness, it causes the intestine to contract and speed the flow of faeces to the rectum. Yellow bile may also enter the stomach. This is not a natural process and will produce heartburn, griping pains around the stomach and vomiting. (7)

The thicker and earthier residue is black bile. It is taken by the left branch of the portal vein ('vena lienalis') to the spleen. (8) In the same manner as the liver draws chyle to itself to render it into nourishment, the spleen attracts black bile as its food and assimilates it to its substance. Once the black bile has entered the spleen it

remains there for some time because of its obduracy to change. The large number of arteries and veins near the spleen are explained by the difficulty of concocting and assimilating black bile to the substance of the spleen, for they produce the extra amount of heat required for the digestion of black bile. (9)

The part of black bile which is not fully transformed by the spleen goes through 'a short vessel' (10) to the upper part of the stomach. In contrast to yellow bile, black bile has a natural and beneficial function when it enters the stomach. In the 'Use of Parts' Galen wrote:-

"The part of the atrabilious residue which cannot be elaborated and transformed in the spleen is discharged not into the intestines near the anus, but into the stomach itself ... and the quality of the black bile is proof that it does no harm to the stomach. For it is astringent and acid and naturally draws the stomach together and contracts it but does not upset it, as the yellow bile does. Hence it is clear that if we say that the latter is injurious because it does not allow the food to remain in the stomach to be concocted, we shall find the black bile wholly innocuous and even beneficial to the action of the stomach, for it tightens and draws together the stomach and compels it to clasp the food closely and retain it until it is completely concocted. This is the foresight with which Nature has arranged the dis- (11) charge of the bilious residues."

Although the function of black bile when in the stomach is beneficial, it should be understood as an additional but not essential help in digestion; as Galen thought that the flow of black bile to the stomach was irregular.

Galen's explanation of how urine, the major waste fluid in the body, is separated out of blood by the kidneys and attracted to the bladder is also based upon the common

concepts used in the system of digestion. The use of the same explanation, that of the digestive process, to explain the flow of waste fluids, their retention by certain organs and their expulsion, produces a sense of completeness and rational coherence. There is no improvised 'ad hoc' explanation for the waste fluids but rather they take their place in the general plan by which Nature enables the body to remain nourished. Galen wrote approvingly of Hippocrates who:-

"expresses his admiration of her [Nature] ... she has, as he supposes, certain faculties, one attractive of what is appropriate, and another eliminative of what is foreign, and she nourishes the animal, makes it grow and expels its diseases by crisis. Therefore he says that there is in our bodies a concordance in the movements of air and fluid, and that everything is in sympathy." (12)

Hippocrates made the statement of belief in Nature's providence, Galen worked out in detail the steps by which Nature orchestrated the motion of the fluids.

Black bile gained in credibility by the fact that it was explained in the same terms as Galen had used to explain the physiology of digestion. The functions of yellow bile and black bile, in the intestines and stomach respectively, are also placed in the framework of the digestive system. This in fact also helps to improve the credibility of black bile for not only does it explain how it can be produced normally but its stay in the body can also be justified. In the sixteenth century the existence of black bile was doubted for a while, when the vein connecting the spleen to the stomach could not be found. However, its existence was

reconfirmed when the vas breve between spleen and stomach was discovered and even when anatomists supported the Aristotelean view of the spleen's function black bile or something with the same attributes as black bile remained in existence. This, I think, indicates the extent to which Galen had embedded black bile into the matrix of his digestive system.

If, however, we look at what went before the finished product to Galen's proof of the existence of black bile and to the ideas of previous writers, the sense of polished coherence tends to diminish.

Galen's proofs for the existence of black bile.

In the Natural Faculties Galen attempted to prove that black bile exists and that the function of the spleen is to concoct it. His proof is in two parts. In Chapter IX of Book II of the Natural Faculties he ended the major part of his proof by stating that:-

"I, however, for my part, have demonstrated, firstly from the causes by which everything throughout nature is governed (by the causes I mean the Warm, Cold, Dry and Moist) and secondly, from obvious bodily phenomena, that there must needs be a cold and dry humour ... this humour is black bile ... the viscus which clears it away is the spleen" (13)

Brock comments in a footnote on this passage: "Thus Galen has demonstrated the functions of the spleen both deductively and inductively." (14) The extent of the historical precedents for Galen's ideas as well as an examination of the

proofs themselves will help in assessing the relative importance of the inductive and deductive parts of the proof.

The first proof relies on the argument that there are four combinations of the Aristotelian qualities which constitute the world and that the same must apply in the case of the human body. After Galen showed that blood, yellow bile and phlegm are agreed upon, he then stated:-

"If then, there is a warm and moist humour [blood] and another which is warm and dry [yellow bile], and yet another which is moist and cold [phlegm], is there some which is virtually cold and dry? Is the fourth combination of temperaments, which exists in all other things non-existent in the humours alone? No; the black bile is such a humour. This, according to intelligent physicians and philosophers, tends to be in excess as regards seasons, mainly in the fall of the year, and, as regards ages, mainly after the prime of life. And similarly, also they say that there are cold and dry modes of life, regions, constitutions and diseases. Nature, they suppose, is not defective in this single combination; like the three other combinations it extends everywhere" (15)

It then follows from the universal applicability of the doctrine of qualities that a cold and dry humour must exist. In other words the existence of this humour is not based on empirical observation. Nor is Galen's identification of this cold and dry humour given on any empirical grounds in the present context. Indeed, it merely forms an assertion which is neither logically nor empirically connected with the doctrine of qualities. By contrast the second part of the proof does rest upon empirical observation and draws upon the appearance of disease symptoms to show that observational evidence for black bile exists and that the spleen draws and concocts the black bile. At first

Galen argued from a priori grounds that some organ must exist to eliminate black bile, because nature would not allow a fluid deleterious to man to flow around the body:-

"At this point, also, I would gladly have been able to ask Erasistratus whether his 'artistic' Nature has not constructed any organ for clearing away a humour such as this. For whilst there are two organs for the excretion of urine, and another of considerable size for that of yellow bile, does the humour which is more pernicious than these wander about persistently in the veins mingled with blood." (16)

Galen has stated here that black bile is not a 'good' humour and, therefore by implication, not a normal fluid of the body, whereas in the argument from the universality of the four qualitative combinations the implication must be that black bile is a normal and proper fluid of the body - of the type seen in Galen's digestive system. This difference is important because it serves to distinguish between the physiological explanation of black bile which considers black bile to be normal and the humoral in which black bile acts as an agent or symptom of disease and is therefore abnormal.

Galen stressed the pernicious nature of black bile not only to point to the necessity for clearing it away, but because the evidence from disease and from the older authorities was drawn from the humoral doctrine of disease and would have appeared more authoritative to his readers. This is clearly shown when Galen continued and quoted Hippocrates on the effect of black bile upon some one suffering from dysentery in order to stress the harmful nature of black bile:-

"Yet Hippocrates says, 'Dysentery is a fatal condition if it proceeds from black bile'; while that proceeding from yellow bile is by no means deadly, and most people recover from it; this proves how much more pernicious and acrid in its potentialities is black than yellow bile."⁽¹⁷⁾

Galen then attacked Erasistratus for holding that "an artistic Nature would have prepared so large an organ [the spleen] for no purpose." In order to prove that the spleen does, indeed, have a purpose Galen invoked the authority of "not only Hippocrates and Plato" but also of "thousands of the ancient physicians and philosophers as well" that "this viscus is one of those which cleanse the blood."⁽¹⁸⁾ Although Galen did not explicitly make the point, it is clear that the only impurity of which the spleen could clean the blood is black bile. For at the beginning of the second part of his proof (see above) Galen stated that there are already two organs for the excretion of urine and yellow blood and therefore, granted the reality of black bile and the fact that it is the only other impurity in the blood (phlegm is accounted for elsewhere), then the only excrement that the spleen can eliminate must be black bile. One difficulty with this, as was pointed out in the late sixteenth century was that Hippocrates in De morbis⁽¹⁹⁾ had stated, not that the spleen cleansed the blood, but that the spleen drew water out of the blood. Also in a list of the humours Hippocrates, in De semine, did not mention black bile but blood, phlegm and water.⁽²⁰⁾

So far this second stage of Galen's proof has been concerned in showing that the spleen is the organ that clears

away black bile rather than demonstrating that black bile exists. The reality of black bile has been assumed but not proved. However, Galen went on to try and show that black bile and splenic function can be inferred from disease symptoms. First he quoted the opinion of Hippocrates to the effect that "the spleen wastes in those people in whom the body is in good condition, and all those physicians also who base themselves on experience agree with this."⁽²¹⁾ Having established that the normal size of the spleen is small Galen then considered the cases of an enlarged spleen:-

"Again, in those cases in which the spleen is large and is increasing from internal suppuration, it destroys the body and fills it with evil humours; this again is agreed on, not only by Hippocrates, but also by Plato and many others including the Empiric physicians. And the jaundice which occurs when the spleen is out of order is darker in colour, and the cicatrices of ulcers are dark. For, generally speaking, when the spleen is drawing the atrabiliary humour into itself to a less degree than is proper, the blood is unpurified, and the whole body takes on a bad colour."⁽²²⁾

By pointing out the presence of melanoid skin characteristics in cases of an enlarged spleen Galen was able to lend support to the presence of black bile and to the function of the spleen in eliminating it from the body.

Galen also took care to show that his explanation of the damage caused by a malfunctioning spleen was not 'ad hoc' but similar to those used to explain malfunctions of other organs:-

"Thus, just as the kidneys, whose function it is to attract the urine, do this badly, when they are out of order, so also the spleen, which has in itself a native power of attracting an atrabiliary quality if it ever happens to be weak

must necessarily exercise this attraction badly, with the result that the blood becomes thicker and darker." (23)

If one tries to answer the question of whether Galen, in fact, has "demonstrated, firstly from the causes by which everything throughout nature is governed ... and secondly, from obvious bodily phenomena that there must needs be a cold and dry humour", the answer must be yes for the first and no for the second proof. Granted the truth of the hypothesis of Aristotelian qualities and its universality then its applicability to the microcosm of man must be demonstrated. However, what has been proved is the existence of a 'cold and dry humour' in the body and not necessarily black bile.

The proof from the phenomena and tradition is really concerned with black bile and splenic function; Galen does not discuss or prove that black bile is the cold and dry humour - he only asserts it. Galen, however, does transpose the inductive argument about black bile to the cold and dry humour. In this way the symptoms from disease not only confirm the existence of black bile, they also confirm the deductive argument that the cold and dry humour exists.

There is a further point that can be made about the second proof. It does not prove the existence of black bile 'ab initio'. The symptoms tend to confirm the reality of black bile but only because there was some prior conception of the hypothesis of black bile. To that extent the importance of the observation of symptoms is lessened.

The first proof has the greater impact on an abstract level whilst the second appears to have greater observational force. The first argument proves a combination of qualities whilst the second proof confirms a material substance. This is not sufficient to decide on the relative importance of the two proofs. What is decisive is that the idea of normality is implicit in the idea of the cold and dry humour whilst black bile is seen as abnormal. It would thus seem that if Galen is to produce a coherent theory of normal physiology as opposed to pathology it is the first proof of the cold and dry humour which is the more important. This is, in fact, made explicit by Galen in his discussion of the ancient writers when, in an attempt to equate their views with his own, he distinguishes between a normal and an abnormal black bile, the one being equated with the physiological humour and the other with the pathological.

The ancient writers on the spleen and black bile.

Before looking at Galen's discussion of the opinions of the ancient writers it will be useful to give a short exposition of the views of Hippocrates, Plato and Aristotle. This will also serve as background information when examining the sixteenth century writers, for they used the opinions of Galen's predecessors against him.

There is no coherent physiological theory of black bile in the Hippocratic Corpus. It was mentioned previously that

black bile was not listed as a humour and that according to Hippocrates the spleen does not draw black bile from the blood. Black bile is however seen as a pathological agent or symptom of disease. Some of the Aphorisms deal with black bile and they give an idea of the loose sense in which black bile was considered:

"When black bile is evacuated in the beginning of any disease whatever, either upward or downward, it is a mortal symptom." (24)

"Dysentery, if it commence with black bile is mortal." (25)

Two of the Aphorisms are almost contradictory when dealing with dysentery and the spleen:-

"When persons having large spleens are seized with dysentery, and if the dysentery pass into a chronic state, either dropsy or lientery supervenes and they die." (26)

And:-

"In enlargement of the spleen, it is a good symptom when dysentery comes on". (27)

In the Epidemics no clear distinction is made between yellow and black bile. The discharges are often mentioned as bilious and are viewed as symptoms of the progress of the illness, when a cure has occurred the discharges are sometimes seen as causes of the disease, their evacuation producing the cure. (28)

In the treatise On Regimen in Acute Diseases black bile is differentiated from yellow ('bitter') bile:-

"In a word, the acidity of vinegar agrees rather with those who are troubled with bitter

bile, than with those patients whose bile is black; for the bitter principle is dissolved in it and turned to phlegm, by being suspended in it; whereas black bile is fermented, swells up and is multiplied thereby; for vinegar is a melanagogue."(29)

The treatise considers that many pathological conditions are produced by accretion of humours in the body, and black bile is mentioned as one such humour:-

"When pains precede, and there are influxes of black bile and of acrid humours, and when by their pungency the internal parts are pained, and the veins being pinched and dried become distended, and getting inflamed attract the humours running into the parts, whence the blood being vitiated, and the airs there collected not being able to find their natural passages, coldness comes on in consequence of this stasis with vertigo, loss of speech, heaviness of the head ... " (30)

The treatise also mentions the fact that the spleen can collect humours in itself, but black bile is not specifically identified:-

"Hypochondria ... tension of the diaphragm ... when these complaints are connected with obstructed respiration; but more especially strong pains of the liver, heaviness of the spleen ... (31) diseases connected with collections of humours."

On Ancient Medicine also states that the spleen draws fluid to itself. Although it is more detailed, the description does not specify the type of fluid involved:-

"But spongy and rare parts, such as the spleen, the lungs and the breasts drink up especially the juices around them and become hardened and enlarged by accession of juices ... For it is not with the spleen as with the stomach, in which there is a liquid, which it contains and evacuates every day; but when it (the spleen) drinks up and receives a fluid into itself, the hollow and lax parts of it

are filled ... and instead of being rare and soft it becomes hard, and dense, and it can neither digest nor discharge its contents: these things it suffers, owing to the nature of its structure." (32)

It is interesting to note that the drawing of fluid by the spleen is not a normal function, for a pathological condition is produced which is explained by the fact that the structure of the spleen is incapable of digestion. This, again, emphasises that the Hippocratic corpus was concerned with pathology whilst Galen, who does give the spleen a digestive function, was also concerned with physiology.

The passages that have been quoted show that black bile was mentioned by Hippocrates and that the spleen was thought to draw fluids or humours to itself. However, black bile was not identified as the cold and dry humour nor was it stated that the spleen drew black bile, but it was specifically denied that the spleen could digest any humour. These are the points upon which Galen's physiological account of the spleen and black bile is based and there is no support for them in Hippocrates.

Plato, in the Timaeus, does appear to hold an opinion closer to Galen's idea of the spleen as the organ which digested a humour. Plato did not specify that it was any one type of humour which was drawn by the spleen but rather impurities in general, especially from the region of the liver:-

"The structure and position of the organ immediately on its [the liver's] left enable it to keep the liver bright and clean, like a duster kept handy to clean a mirror. For the spleen, whose texture is hollow and bloodless, absorbs and clears away any impurities which occur in the region of the liver because of diseases in

the body. When filled with these impurities it becomes swollen and infected, but when the body is purged it subsides and resumes its original state. (33)

There is a greater sense of the spleen as an absorber of impurities but, again, the spleen is not able to digest the impurities as part of its function.

Plato also discussed the formation and nature of the humours. The decomposition of flesh, when discharged back to the veins, produces in the blood "a variety of colours and bitternesses, as well as acid and salty qualities, and develops bile, serum and phlegm of all sorts. These undesirable and corrupt products first destroy the blood itself ... "(34) Plato distinguished between two or more types of bile. One was bitter and black and "becomes an attacking agent dangerous to any part of the body." This could change: "it remains black but acquires acidity, losing its bitterness which is largely refined away." Again it "sometimes retains its bitterness but an infusion of blood gives it a reddish tinge", and "finally, when the flesh decomposed by the inflammation is of new formation, yellow colour and bitterness are combined." Plato commented that: "the common name of all these products is bile ... the sub species commonly recognized are each identified according to its particular colour." (35)

There is no idea here that the bile is a residue from the liver nor is yellow or black bile given a specific organ in which it is concocted. There is, nevertheless, the idea that there is a gradation of virulence in the various types

of bile and this is echoed in Galen's work. Another idea is that there is some relationship between the malignancy of bile and heat. Plato stated:-

"black and acid bile, when heat gives the mixture a saline quality is a dangerous substance known as acid phlegm." (36)

Also:-

"All kinds of inflammation (so called from the burning and heat which characterizes them) are caused by bile ... The worst is when it mixes with pure blood and causes disorder in the fibrine (37) ... As the flow of bile increases, its heat overcomes the fibrine and throws it into seething confusion; and if it finally succeeds in getting the upper hand, it penetrates to the marrow, burns through the soul's mooring cables and sets it free .. (38)

Galen was to consider that heat could cause normal black bile to become malignant and the degree of change depended on the degree of heat.

The ancestry of some of Galen's ideas can be traced back to Plato. The 'likely story' of the Timaeus is vague enough for Galen to think that he was being faithful to Plato's ideas. However, the close relationship between black bile, anatomy and the theory of digestion which characterizes Galen's work is not in the Timaeus, for that was not the purpose of the story.

The last of the ancient writers whom I will consider is Aristotle. Aristotle is important because he provided the sixteenth and early seventeenth century writers with an alternative theory to Galen's on the function of the spleen. In the Parts of Animals, (39) Aristotle stated that the spleen had been placed on the left side of the body as a

counter-balance to the liver. As it was on the less noble side it was in fact a kind of bastard or counterfeit liver. This meant that, although it had the same function as the liver, the blood that it produced was less noble and pure. Aristotle is not cited by Kühn in the Index of Galen's Works as being mentioned by Galen in connection with the spleen or black bile. The only possible mention of Aristotle's view that I have found is a very indirect one in Chapter I of the eleventh Book of the Anatomical Procedures. There Galen wrote that

"you will find the whole of the bodily parts in the two halves of the body resembling one another, that is in the right and left halves. Their similarity consists not only in their number, but also in their mass, and form and their whole nature with the exception of the liver and the spleen. Admittedly when you look at the measurements of their structures you find these two organs resembling one another as we have shown before. However, if you consider their form and disposition, then you find them unlike one another, (40) inasmuch as the liver is not like the spleen."

We can conclude that if Aristotle's views on the spleen are conspicuous by their absence in Galen's writings, that neither in Hippocrates nor in Plato can we find the characteristic elements of the physiological ideas of Galen. The pathological side of the inductive proof of the Natural Faculties can be found, but the cold and dry humour is not equated with black bile, or black bile seen as a humour. Finally, the function of the spleen, although developing as an idea, is not near Galen's teaching that one specific humour is drawn to the spleen and that the spleen can digest it.

It is not surprising that Galen's physiological theory is not to be found in Hippocrates. Although the humours are thought of as constituents of the body on whose good mixture ('eucrasia') depended the health of the body, the main emphasis in the Hippocrates^{ic} corpus is on the bad mixture ('dyscrasia'), which produced illness. The relation of specific humours to certain anatomical structures and to a general physiological theory is the achievement of Galen. Paradoxically, at least for our times, Galen tried very hard to cover up his originality.

An analysis of the passage in the Natural Faculties where Galen gave an account of the ancient opinions on black bile shows that the physiological theory of black bile is his own invention. Although Galen wrote that he was giving the views of the ancients, he in fact changed them. The result is that the account is his own although it purports to be that of the old authorities. It is the nature of the changes which show how Galen transformed a pathological theory to a physiological one; the changes also indicate the strain on coherence which was involved. At the end of his two proofs Galen wrote:-

"What else, then, remains but to explain clearly what it is that happens in the generation of the humours according to the belief and demonstration of the Ancients?" (41)

Galen then proceeded to explain what the ancients believed by making a comparison with the fermentation of new wine. He wrote that if we imagine "two residual substances produced during this process of alteration", one being called

the "flower" of the wine, "light and air-like" and the other "the lees" tending to be "heavy and more of the nature of earth":-

"you may correctly compare yellow bile to the first of these and black bile to the latter." (42)

This comparison with fermentation gives an insight not only into the way that yellow and black bile are produced but also how blood is produced from chyle. In keeping with his desire to generalise and have similar causes for similar processes Galen stated that the pressed grape:-

"is fermenting and undergoing alteration through the agency of its contained heat." (43)

The comparison with fermentation gives a vivid picture of how chyle is changed into blood by the innate heat of the liver. The idea that the production of two kinds of residue from the alteration of chyle to blood is a normal physiological process is given force, I think, by the fact that Galen is able to find a process of digestion which was well known to most people.

After Galen had written that yellow bile and black bile could be compared with the flower and the lees of the wine respectively, he went on to distinguish between normal and abnormal bile:-

"these humours have not the same appearance when the animal is in normal health as that which they often show when it is not so; for then the yellow bile becomes vitelline, being so termed because it becomes like the yolk of an egg, both in colour and density; and again even the black bile itself becomes much more malignant than when in its normal condition, but no particular name has been given to [such a condition of] the

humour, except that some people have called it corrosive or acetose, because it also becomes sharp like vinegar and corrodes the animal body - as also the earth, if it be poured on it - and it produces a kind of fermentation and seething, accompanied by bubbles - an abnormal putrefaction having become added to the natural condition of the black humour." (44)

Here Galen is perhaps repeating Plato's idea of a bile that can change and become corrosive and acid. Walter Pagel (45) has described how the Paracelsans and Van Helmont developed the concept of an acid (hydrocholic acid) which was the chief agent of digestion and which possessed similar attributes to black bile. However, as Dr. Pagel points out Van Helmont specifically contrasted his acid with the black bile of the 'Schools'.

Galen's statement that the ancients did not give abnormal bile a particular name is in a sense correct (Plato stated that the various pernicious fluids were all known as bile). (46) It is not, in fact, surprising that both in the Hippocratic writings and Plato, abnormal bile had no distinguishing name. There was no idea of a normal black bile and so when black bile is spoken of it is understood in the pathological sense as being harmful to the body and not in the physiological sense of a normal by-product of the body. Galen's desire to rationalise humoral pathology naturally meant that he would expect normal black bile to be unqualified and the abnormal black bile to be qualified by some adjective.

However Galen appeared to contradict his statement that the ancients gave no special name to abnormal black bile when he stated that:-

"It seems to me also that most of the ancient physicians give the name black humour and not black bile to the normal portion of this humour, which is discharged from the bowel and which also frequently rises to the top [of the stomach contents]; and they call black bile that part which, through a kind of combustion and putrefaction, has had its quality changed to acid." (47)

Neither in Hippocrates or Plato have I found such a clear distinction between black humour and black bile. It may be that Galen wished to show that the ancients did have an idea of normal black bile and that they considered it, moreover, as one of the four humours. It is difficult not to see this as a piece of history fabricated by Galen. The normal black humour is closer to the cold and dry humour than the deleterious black bile. More importantly Galen is able to show the progress from normal black bile or humour to abnormal black bile. He could start with physiologically normal black bile which is changed to the pathological black bile through excessive heat. Galen was presented by history with the concept of black bile as deleterious, and hence, if he was to place black bile in a physiological theory - that is to show how black bile was generated by a normal process - Galen had to alter the bad quality of black bile. By making the ancients appear to have distinguished between a black humour and black bile Galen appeared to agree with authority and at the same time he had established the fact that there was a normal type of black bile. He would also be able to explain, if he wanted to do so, why the ancients had no name for abnormal black bile, as now the word 'humour' implies normality and 'bile' abnormality.

Galen closed the subject with one of his customary comments that "There is no need, however, to dispute about names."⁽⁴⁸⁾ Despite the disclaimer, the names in this particular instance are, if not important, at least interesting.

The passage in the Natural Faculties goes on to describe in greater detail the genesis of the humours and the type of food that they are derived from. Galen then came back to the idea that the abnormal humour is produced by too much heat. Yellow bile, "when, having been roasted to an excessive degree, it becomes yellow, fiery and thick like the yolk of eggs ... is already abnormal."⁽⁴⁹⁾ The same cause operates in the case of abnormal black bile:-

"Similarly with the black humour: that which does not yet produce, as I say, this seething and fermentation on the ground, is natural, while that which has taken over this character and faculty is unnatural; it has assumed an acridity owing to the combustion caused by abnormal heat and has practically become transformed into ashes. In somewhat the same way⁽⁵⁰⁾ burned lees differ from unburned ... "

Again, Galen has stressed the difference between normal and abnormal bile.

The slight similarity with Plato in the emphasis on heat and degree of harm which can be caused is increased when Galen tried to explore the full implications of his scheme both in the rational and physiological sense. He considered that if the heat were strong enough, "the vitelline bile [abnormal yellow bile] also may take on the appearance of this combusted black bile, if ever it chance to be roasted, so to say by fiery heat."⁽⁵¹⁾ In fact Galen saw

all types of abnormal bile as having the capacity to range between the gradations of abnormal yellow bile and abnormal black bile:-

"And all the other forms of bile are produced, some from a blending of those mentioned, others being as it were, transition-stages in the genesis of these or in their conversion into one another." (52)

This wide range of abnormal bile is very similar to the range of biles described in the Timaeus.

However Galen only granted gradation and transformation to the abnormal biles. The difference between the thin normal humour of yellow bile and that of the thick black bile is retained:-

"And they differ in that those first mentioned are unmixed and unique, while the latter forms are diluted with various kinds of serum." (53)

This can be understood by the Aristotelian doctrine of qualities. As the abnormal biles are mixtures they can be graded according to the relative mixture of their qualities but as the normal biles are 'unmixed and unique' there can be no gradation of their qualities and they always retain the same nature and the same qualitative difference between themselves.

That the black 'humour' remains unchanged whilst the 'biles' vary in degree of harmfulness illustrates again how Galen tried to establish the doctrine of the normal bile in contrast to the abnormal bile which caused disease. The qualitative nature of the normal humour had to stay constant if it was to form part of the normal physiological system

of the body, whilst the variation in degree of the quality of the biles corresponds to the degrees of severity in diseases caused by bile.

A certain strain becomes apparent beyond this point in Galen's writing. Galen explored further logical possibilities and added a distorted piece of Plato's thinking to his own theory. The result is that the Galenic doctrine of black bile begins to lose coherence. Having argued that there was a normal and abnormal type of bile, Galen went on to say that the normal type of bile was not really normal but was inimical to the body. He had previously stated that if the spleen could not function then black bile would circulate through the body.⁽⁵⁴⁾ As black bile cannot be assimilated by any organ apart from the spleen the conclusion is inescapable that a surfeit of normal black bile following injury or disease to the spleen would harm the body.

Galen establishes that the normal humours can be harmful by applying the idea of a deleterious serum - perhaps taken from the Timaeus - not only to the abnormal but also to the normal humour:-

"And they differ in that those first mentioned are unmixed (normal biles) and unique, while the latter forms are diluted with various kinds of serum. And all the serums in the humours are waste substances, and the animal body needs to be purified from them" (55)

In the first sentence the serums are used to distinguish between normal and abnormal biles. In the second sentence the transposition occurs whereby the 'humours' (normal) contain serums which are "waste substances" - this incidentally,

contradicts the first sentence.

Galen discussed the role of the humours and was able to give part of them the physiological function of thickening blood. The reference to Plato seems to be a distortion of the Timaeus⁽⁵⁶⁾ where black bile is said to destroy the fibres in the blood:-

"There is, however, a natural use for the humours first mentioned, both thick and thin; the blood is purified both by the spleen and by the bladder beside the liver, and a part of each of the two humours is put away, of such quantity and quality that, if it were carried all over the body, it would do a certain amount of harm. For that which is decidedly thick and earthy in nature, and has entirely escaped alteration in the liver, is drawn by the spleen into itself; the other part which is only moderately thick, after being elaborated [in the liver] is carried all over the body. For the blood in many parts of the body has need of a certain amount of thickening, as also of the fibres which it contains. And the use of these has been discussed by Plato." (57)

The reasons why Galen ended up by making the humours harmful are bound up in the two different conceptions of the humours, one being that they are the substances of the universal qualitative combinations, the other that they are always potentially dangerous and more often than not a collection of waste products. If Galen was to use black bile as a cause of disease then it had to have harmful properties from the very beginning despite his attempt to circumvent this by having normal and abnormal biles.

Galen closed the passage by generalising his account so that it included phlegm, and he made the same distinction between good and bad:-

"just as in the case of each of the two kinds of bile, there is one part which is useful to the animal and in accordance with its nature, while the other part is useless and contrary to nature, so also it is with the phlegm" (58)

This type of generalization is a typical example of Galen's endeavour in the Natural Faculties to provide uniformity and coherence in his account of the humours.

Nevertheless, Galen's account of "the genesis and destruction of the humours" is not completely coherent. The ancient writings had not made the distinction between normal and abnormal biles. The rather rambling progress of the argument has a certain 'ad hoc' element as seen in the discussion about nomenclature, serums, the harmfulness of normal black bile and the reference to Plato.

One reason for this is that there is little observational evidence to argue about, either in Galen's physiological account or in the writings of the ancients as given by Galen. The tendency to pile idea upon hypothesis and enjoy verbalising is probably increased by the lack of anatomical reference. On the other hand, in the sixteenth century there was particular emphasis on anatomical observation but the capacity to create original hypotheses was signally lacking in most of the anatomists.

Galen's description of the writings of the old authorities has, I think, shown that the physiological account of black bile is his own creation. It has also made it clear that the description of the nature of bile is less coherent than Galen's account of the place of black bile in his theory

of digestion. The more general reasons why this is so are discussed briefly below.

A note on the Hippocratic and Aristotelian doctrine of qualities.

In the Natural Faculties Galen wrote:-

"In fact, of all those known to us who have been both physicians and philosophers Hippocrates was the first who took it in hand to demonstrate that there are, in all, four mutually interacting qualities, and that to the operation of these is due the genesis and destruction of all things that come into and pass out of being. Nay, more; Hippocrates was also the first to recognize that all these qualities undergo an intimate mingling with one another; and at least the beginnings of the proofs to which Aristotle later set his hand are to be found first in the writings of Hippocrates." (59)

By calling Hippocrates both a physician and philosopher (this is often repeated) Galen pointed out the two essential elements in the Hippocratic writings on the humours. In so far as the Hippocratic corpus is concerned with the qualities that go to make up the nature of the world there are definite similarities with the later work of Aristotle. However doctors were concerned with the practicalities of their art and instead of merely developing a qualitative theory on a universal level Hippocrates applied the idea of qualities as a means of understanding the symptoms and causes of illness and also its treatment.

The often misunderstood writer On Ancient Medicine did not complain that medicine was dabbling with hypothesis but rather that it was applying the qualitative hypothesis in treatment:-

"But I wish the discourse to revert to the new method of those who prosecute their inquiries in the Art by hypothesis. For if hot, or cold, or moist, or dry, be that which proves injurious to man, and if the person who would treat him properly must apply cold to the hot, hot to the cold, moist to the dry, and dry to the moist ..."(60)

The writer then went on to state that no food contains unmixed qualities and that, in fact, if one is to feed, and so treat, an ailing man it must be with food that his constitution is used to and not by some food opposite in quality to the quality of the illness.

The treatise, in its attack of the application of a universal hypothesis to narrow and practical purposes, indicates precisely the way in which the qualitative doctrine is developed in Hippocrates. In Aristotle, on the other hand the purpose of the theory of qualities is that it should be part of a general explanatory system of the world.

The attempt by Galen to equate black bile with the 'cold and dry humour', in the same way as Aristotle had made the elements the substances of the four qualitative combinations, was bound to fail. There was no room in Galen's thinking for external causes of disease apart from dyscrasiae and structural malfunction. The humours had to be the causes of disease and this necessity means that it is in the Hippocratic and not the Aristotelian sense that Galen viewed the humours.

Conclusion

Most of the terms of the debate about black bile and the spleen which concerned the sixteenth century anatomists were laid down by Galen. The need to take tradition into account, the strength of the humoral theory and the attempt to produce a physiological theory of the humours are all present when the debate is resumed. Apart from viewing Galen's work as a prelude to the sixteenth century, we can also find out something about the intrinsic nature of Galen's thinking by examining his analysis.

There is no doubt that Galen's originality stemmed from his ideas on the physiological nature of the humours. The balance comes down on the first or deductive proof of black bile. But the influence of the inductive second proof with its tradition and explanation of the causes of some illnesses, meant that Galen could not escape the pathological element in the doctrine of humours. Indeed, it is doubtful if he really wanted to.

CHAPTER IITHE ANATOMISTS AND THE SPLEEN BEFORE 1578

One is faced with quite different problems from those encountered in the last chapter, when trying to understand the work of the sixteenth century anatomists. The fundamental difference is that it was Galen who created the theory of black bile and the spleen and not the anatomists of the renaissance. Galen produced a rational theory by joining together a priori ideas of the qualitative constitution of the body with apparently empirical evidence of pathological conditions. As my analysis of Galen's theory showed, the importance of universal or a priori considerations ~~is~~^{is} revealed by the way he rationalised the pathological aspects of black bile to make them match the physiological theory. Although the sixteenth century anatomists could try to confirm or to refute parts of Galen's theory by their observations, they did not feel the need to examine the rational nature of the theory on a priori grounds or to posit a new theory derived from their own creative thinking. The anatomists did in some cases substitute Aristotle's view of the spleen's function for Galen's, either because of observational findings in anatomy or because of general philosophical predispositions. However, this substitution of theories betrays no sign of original thought.

What was original and new in the work of the renaissance

anatomists was the desire to observe afresh, or often for the first time, the anatomy of the human body. This contrasts with their neglect of basic physiological theories, especially where these were not correlated with observational details. My thesis attempts to explain this situation and I am especially concerned with the way in which there appears to be a barrier in the minds of sixteenth century medical writers between knowledge of the phenomena and their explanation by fundamental or universal theories. In the second part of the thesis I show how a philosophical debate occurred which explicitly articulated this separation. However, by analysing the work of the sixteenth century anatomists one can see how this distinction between basic theory and observation is embedded in the thinking of the anatomists.

I have divided my analysis into two chapters. The first is centred around the figure of Vesalius but I shall also describe some of the writings on the spleen of his immediate predecessors and successors. The second chapter begins when the Aristotelean opinion of the spleen's function becomes increasingly important and the anatomists do not try merely to relate their observations to Galen's theory but attempt to produce and to develop an alternative.

The Pre-Vesalian Period

There was little change in ideas about the spleen from the time of Galen to that of Vesalius. The Anatomia of

Mondino⁽¹⁾ (1316) which was the first record of actual dissection during the Middle Ages was completely Galenic in its description of the spleen and its function in eliminating melancholy. The same is true of the period closer to Vesalius, and I have chosen to illustrate this by examining the writing of one of Vesalius's teachers in Paris. Before doing this, however, I shall consider the one further contribution from the ancient world about the spleen which is of importance.

The tract De Utilitate Respirationis is a short work comprising some five and a half folio pages of the third (1556) Junta edition of Galen's works. On the title page the work was entitled 'The Book Attributed to Galen on the Usefulness of Breathing'⁽²⁾ and the editors listed it under 'Spurii Libri'. This opinion, as we shall see, was also held by Vesalius, himself a former contributor to the Junta edition.

The Aristotelean bias of the work is such that it would have been a very ignorant man indeed who thought that Galen had written it - and sixteenth century anatomists were not ignorant of Galen. A sign of this bias is the way in which the writer of De Utilitate Respirationis tried to express the primacy of the heart and to follow in Aristotle's footsteps. Two sentences are sufficient to illustrate this:-

"Aristotle, in fact, says that the ultimate digestion of food is made in the heart and that the blood is generated in the ventricles of the heart. Aristotle also says that the first and most useful instrument of all the senses is the heart, and not the brain as certain people assert."⁽³⁾

The writer went on to give reasons for approving this opinion of Aristotle's such as the fact that it is impossible for pain to originate in any other part of the body without troubling the heart and if a great deal of pain occurs then it produces heart failure.⁽⁴⁾ Galen had believed that the brain was the seat of sensation and he considered that his proof of this had demolished Aristotle's position and had provided him with one of his greatest triumphs.⁽⁵⁾ It is clear therefore why De Utilitate Respirationis was not considered to be a work of Galen.

In his explanation of how the heart perfectly digests blood, the writer of De Utilitate Respirationis touched upon the function of the spleen. As his views were to be developed in the later part of the sixteenth century it is worth while describing some of their details. He wrote that the heart:-

"also attracts the juice of food from the hollow vein of the liver, because as Aristotle says, 'in the heart is digested blood perfectly made'. Moreover, the heart again draws from the intestines the juice of food from other places than through the liver, that is, through the middle artery; for the artery which extends from the heart through the back and is joined to the mesentery does not pass through the liver since Aristotle says, 'in the liver there is no artery at all.'"⁽⁶⁾

The writer of course had no idea of the circulation of the blood; therefore, what he writes did not appear impossible to his contemporaries or indeed to the anatomists of the sixteenth century, and an arterial route for the transmission of chyle to the heart could be envisaged. The writer came

back to the connection of the heart with the mesenteric veins and wrote:-

"I say also that the mesaraicum through which the juice of food passes from the intestines through the whole body, is not only joined to the hepatic veins but also to a certain artery which proceeds from the back and does not go through the liver: as all who have written about anatomy bear witness; it is clear from this that the juice of the food is not entirely transmitted to the hepatic vein but also partly to the artery." (7)

What the writer of De Utilitate Respirationis has done is to show (or rather to assert) that the liver need not concoct all the chyle into blood and that it is anatomically possible that some chyle goes directly to the heart and is digested there. In this way he is trying to suggest that Galen's theory that the liver concocts all the blood need not be true. Also, by positing a transmission of chyle which by-passed the liver, the writer prepared the ground for his further assertion that the spleen as well as the liver could concoct blood. However, the idea of the arterial flow of chyle to the heart is not directly linked with the function of the spleen. The writer declared:-

"I say also that just like the liver so also the spleen attracts the juice of food from the intestines through the middle mesentery to which the vein of the spleen has been joined in the same way as the vein of the liver. Therefore the spleen, as Aristotle says, can rightly be called the left liver. Likewise there extends a vein from the heart to the spleen just as to the liver, through which the heart attracts to itself the juice of food from the spleen in the same way as from the liver." (8)

The work ended with the writer's praise of Aristotle:-

"I am amazed, however, at how many of the ancients have been ignorant of the use of

the spleen in the human body, [and that] others who imagined that they knew were utterly wrong. Truly, only Aristotle in the book on the parts of animals has written carefully on this subject; he was the only true exponent of the truth."⁽⁹⁾

Vesalius was to use the adjective 'trash' about some of the writer's views. However, towards the end of the sixteenth century Aristotle's ideas on the use of the spleen and those contained in De Utilitate Respirationis became more popular and were developed by anatomists as an alternative to Galen's theory of the spleen. For instance, Ulmus, in 1578, took the two ideas of an artery between the heart and the mesentery and of the spleen's function and produced the concept of an arterial flow to the heart of blood made by the spleen.

De Utilitate Respirationis is important because it provided anatomists with an elaboration of the Aristotelean position of the spleen and so gave them more material from which they could develop an alternative to Galen. Also the number of explicit or implicit references to the work to be found in the work of sixteenth century anatomists indicates the degree of their concern with problems of the physiology of the spleen as opposed to their interest in its anatomy.

Jean Fernel

The work of Jean Fernel provides one of the best ways of understanding the state of early sixteenth century knowledge concerning the spleen. Jean Fernel (1506-1558) taught Vesalius when he was a student in Paris but Fernel cannot be considered the spiritual mentor of his pupil, for the

consuming interest in anatomy was absent in him. Rather, Fernel should be thought of as an outstanding member of the group of writers on medicine in the early years after the recovery and translation of Galen's physiological and anatomical works. Unlike his contemporary Guinther von Andernach who was also a professor at Paris in the same years (1534-1535), Fernel was not only a classical philologist but as Sherrington⁽¹⁰⁾ has pointed out had some claim to original ideas of his own. Unfortunately Sherrington was not aware of the extent of Fernel's debt to Galen and when one examines what Fernel wrote about the spleen in De Naturali Parte Medicinae (1547) no vestige of this originality can be found. De Naturali Parte Medicinae was published after the Fabrica of Vesalius; nevertheless it is a true reflection of pre-Vesalian attitudes.

The description of the function of the spleen contained in De Naturali Parte Medicinae is completely Galenic and throws into contrast the innovation of Vesalius who used his own anatomical observations to examine and perhaps throw doubt on the opinions of Galen. Fernel wrote:-

"The spleen, moreover, bears in the hollow part a vein drawn from the openings of the liver, by means of which, it purges the liver of that foul and melancholic humour." (11)

Here Fernel has asserted the fundamental function which Galen gave to the spleen - that of cleansing the body of melancholy. Fernel went on to repeat some of the details of Galen's theory. He wrote that the ^spleen:-

" . . . by means of hard labour and the utmost management elaborates it [melancholy], breaks it down, wears it away until it changes it into a sort of thin juice, applying for this action both the strength of its innate heat and the perpetual pulsation of the arteries, which in that place are many and large." (12)

This is a repetition of Galen's views on the mechanism of alteration of black bile which I described in the previous chapter. Fernel added another detail concerning the manner by which the spleen changed melancholy:-

"The blood which is drawn into the spleen surpasses in thickness that which is contained in the liver, but when it has been elaborated in its veins and arteries not the whole nor the thicker portion of it but the thinner only becomes the food of the spleen and flows gradually into its flesh." [My italics] (13)

Again, all this is straight from Galen. So Vesalius (who could not have read Fernel's book - although it is possible that he could have heard him lecture on the spleen in Paris) could not see any arteries or veins in the body of the spleen and so wrote that he was in doubt concerning the way that melancholy was changed.

The more one reads of what Fernel wrote about the spleen the more one is struck by the uncritical and almost verbatim repetition of Galen. Fernel repeated the idea that each organ is fed by nutriment appropriate to its own quality and he reiterated Galen's belief that the part of the melancholy humour which could not be assimilated by the spleen went to the stomach and aided its digestion of food by constricting it. Fernel wrote of the thinner type of melancholy:-

"This however, although it is thin, is yet by no means red but has the blackish colour of the spleen, just as the blood which feeds the liver is red and thick: for in this way it was fitting that each should be fed by the humour familiar and related to itself. However, the thicker parts of the melancholic humour which can be neither softened nor broken down by the power of the spleen, as if it were unsuitable for nutrition, is thrown out into the mouth of the stomach by its own duct as if by vomiting. Since it is harsh and sharp it contracts the stomach and makes it narrow so that all its action is firmer and stronger." (14)

I wrote that Fernel appears uncritical. I should add that it is to us today that he seems to be uncritical. This was not a feeling shared by Fernel's contemporaries. Vesalius and his successors might fault Fernel for not paying enough attention to the evidence of his own eyes; but where anatomical observations were not involved, anatomists throughout the sixteenth century were uniformly derivative and uncritical in their writings on physiological function. Alternative theories of function were produced, of course, but generally these were derivative. One has to look outside the medical establishment of the sixteenth century, to Paracelsus or to that maverick member of the establishment, *Argentieri* (see below, chapter 7) in order to find any radical questioning of the views of the ancients on fundamental ideas of function and any new proposal of basic explanations in medicine and biology.

Nevertheless, one is faced with the situation that Fernel's opinions on the spleen are of no intrinsic interest. They are so ~~d~~^e derivative that any attempt to analyse their *le* nature would be to repeat the analysis of Galen's work. The

interest, therefore, of physiological writings like Fernel's lies in their revelation and explanation of the static and derivative attitude to fundamental knowledge that underlay the work of medical writers.

Vesalius

There can be no doubt that the greatest figure in scientific medicine of the sixteenth century was Vesalius. An account of his life would be out of place in this thesis; the biography of Vesalius by O'Malley provides the best description of Vesalius's life and work.⁽¹⁵⁾

That Vesalius did not change the basic ideas of physiology handed down from Galen is well known, that Vesalius disproved or doubted previous anatomical statements - the permeability of the septum is probably the most famous example - is equally well known. What is less often stressed is that although Vesalius's description of general functional theories remained derivative, when his anatomical observations placed any part of Galen's theories in doubt he did not try to 'save' the theory by restating or replacing it by a near equivalent. Vesalius allowed the question mark to remain. This is in sharp contrast to his successors, especially in the later part of the sixteenth century, for they did try to patch up or replace physiological theories which had been put in jeopardy by new anatomical observations. In our eyes the practice of Vesalius in this matter shows him to be greater than the men that followed him;

for, although today we might argue for the close relationship between anatomy and physiology, we would not agree that the choices of possible physiological explanations were limited only to those alternative views propounded a thousand years or more before our time. Yet this was precisely the position of men like Bauhinⁿ and Caspar Hofmann when they wrote on the spleen. Vesalius, by keeping anatomy, or rather new discoveries in anatomy, divorced from physiology except as a means of testing Galen's theories, opened up the possibility that anatomy of itself could help a scientist to arrive at new physiological theories uncontaminated by the qualitative thought of Aristotle or Galen. It must, however, be said that this was only a possibility and did not come to fruition until the time of Harvey and Malpighi.

For this discussion, therefore, Vesalius occupies a partially anomalous position. Most of the anatomists who follow Vesalius confirm my thesis that fundamental theoretical knowledge in medicine and biology was not, in their minds, something to be discovered de novo but rather something to be drawn from the pool of ideas given to them by the classical authorities. Vesalius and the other anatomists agreed that new observational knowledge of the body could be discovered, where they differed was that Vesalius sometimes allowed the doubt concerning previous physiological statements to remain and so made it possible to envisage the discovery of a completely new functional idea to replace the

old one, whereas other anatomists tried to resolve all doubts on the spot. The description that Vesalius gave of the spleen and its relation to black bile confirms this interpretation. Where his anatomical observations did not throw doubt on Galen, Vesalius followed him; in the instances where they did, then he left the matter open to further debate.

The chapter on the spleen in the De Humani Corporis Fabrica of 1543 opened with a typically Vesalian dig at his fellow doctors. He wrote that the position of the healthy spleen was not, as was "thought by the riot of doctors", extended beyond the ribs but that it was enclosed by the ribs as if "by a very safe rampart."⁽¹⁶⁾ With this beginning Vesalius served notice that his account of the spleen was not going to be merely orthodox.

Although this chapter naturally divides into two parts, the first concentrating upon the site, form and structure of the spleen, the second upon the functions of the spleen, there is throughout a constant interaction between Vesalius's anatomical descriptions and his concern with the function of the spleen.

Early in the chapter Vesalius described the colour of the spleen in man; he then wrote that the spleen could be placed in boiling or warm water, to allow it to be handled and examined more easily since the blood in the organ would be no longer fluid but congealed. Vesalius wrote that he did this because, "I was violently in doubt concerning its

use."⁽¹⁷⁾ This doubt about the spleen's function informs many of Vesalius's anatomical comments about the organ and accounts for the interaction between the anatomical and physiological sections of the chapter.

After describing the manner of observing and handling the spleen Vesalius continued:-

"I saw the veins and arteries spread out far otherwise than in the liver, lungs and kidneys. As a matter of fact it seems to me that the substance of the spleen is very thick and black like a rather dense sponge or light pumice . . . being entwined with numerous delicate fibres and filaments." (18)

Vesalius then came to the crucial point of this part of the chapter, writing that although arteries and veins are seen to be inserted in the spleen: "yet none are observed to be spread through its substance in the same way as they are through the substance of the liver and the lungs." Vesalius wrote that the only way that the spleen could be said to be similar would be if the vessels entering the spleen were diffused into countless branches; however those in the spleen are very thin for they are not hollow and so they have been called fibres, rather than vessels.⁽¹⁹⁾ With this description of the internal structure of the spleen and its differentiation from the liver, Vesalius made it more difficult to subscribe to the Aristotelean idea of the spleen as a blood-making organ; for in that case the spleen would need to have a substance similar to that of the liver in order to perform a similar function. Vesalius, with a typical aside, also left the whole question

of the spleen's substance in the air, thereby expressing his doubt and perhaps pointing the way for further investigations into the substance and vascular nature of the spleen. He wrote:-

"And surely it seems that the sole cause of the rarity of the substance of the spleen is not the thin blood which, we agree, feeds the spleen but that entwined infinity of fibres (I hardly dared to say of arteries and of veins). Such appears to me the substance of the spleen in healthy people." (20)

Vesalius described several cases where there had been found, on post mortem examination, abnormalities of the spleen. At the end of his account of these cases, Vesalius wrote:-

"Which I therefore review so that the substance and use of that viscus (if the description of it which Galen gives to it may be lawfully doubted) can be investigated diligently by students." (21)

Vesalius is saying that a knowledge of the pathological condition of the spleen can be helpful for understanding the nature of its substance and of its function. Here one can see the reverse of the Galenic use of pathological evidence to build up a physiological theory which I described in the last chapter. What Vesalius has done is to imply that observations of pathological conditions can be used to test Galen's physiological and anatomical statements.

Vesalius not only gave case reports of diseased spleens but earlier on, when he had described the colour of the spleen, he drew on an analogy between the texture

and colour of the spleen and elephantiasis:-

"But the rest of its surface is not as light as that of the liver or kidneys, but has certain dark and slightly protuberant swellings approximating to that shape usually marked in elephantiasis, the skin of the sufferers unevenly swelling up. The spleen not only corresponds to that unevenness of skin, it portrays, yes in truth, also its colour. For I have seen sufferers from elephantiasis at Paris (in the monastery of St. Lazar), and in many rural parts of upper Germany and elsewhere too, exactly resembling the black colour and surface [texture] of the human spleen even as if it should have been formed in them out of the spleen." (22)

Vesalius used this analogy and the case reports to establish some connection between the spleen and disease conditions. What is interesting is that he included this material in the sections on the site, form and structure of the spleen and the implication is that it is of the same validity and status as the account of the structure of the spleen. It is as if the mere act of observation validates for Vesalius all the implied causal and theoretical elements contained in his association of the spleen with pathological conditions.

In this passage Vesalius confirms the Hippocratic and Galenic belief that elephantiasis was connected with disorders of the spleen. Although Vesalius did not mention black bile in this instance, its mediation between the spleen and the site of disease at the extremities is strongly implied; for a malfunctioning spleen would (in theory) produce an excess of black bile which would collect and form the swellings of elephantiasis. The way in which Vesalius made

the analogy has similarities with Galen's use of the comparison between disease phenomena and the hypothetical black bile to prove the existence of black bile. By using this type of analogy Vesalius showed that he subscribed to the Galenic division between the pathology and the physiology of black bile and the spleen whereby, as I have shown, the pathological elements of the theory of the function of the spleen were considered to be part of the inductive and observational section of the theory and the physiological was deductive and a priori. It would be surprising if Vesalius had thought that he was making a theoretical statement rather than an observational one when he linked the spleen with elephantiasis. The crucial point to note is that when making the analogy Vesalius was recounting his own personal observations; he would have repeated some functional explanation of Galen's if his own observation did not contradict it. Whether Vesalius would have expressed a new idea in physiology which he had thought of himself and which he did not consider as being observational in nature is altogether doubtful.

The post mortem reports that Vesalius recounted are perhaps not so revealing as the analogy between the substance of the spleen and elephantiasis. However, as he had done in his description of the substance of the spleen, Vesalius drew attention to the association between the spleen and elephantiasis. He wrote:-

"In a certain person troubled with elephantiasis which was not yet deep-seated

we found the spleen swollen and distended; in other respects, however, he was like a healthy man."(23)

Vesalius discussed the case of a Paduan prisoner who was "detained in prison for three years, at length having died from black jaundice he was used for a public dissection." The spleen of this man was smaller than normal and generally meagre.(24) There was also a case of enlargement of the spleen, observed during the public dissection of a man who had been hanged. The organ stretched from the front part of the liver across the stomach, but Vesalius did not connect the greatness of the spleen with any disease being content to comment that "the substance of this spleen corresponded with the inside of the viscus of healthy men."(25) The last case that Vesalius described concerned an executed youth used by the students for a public dissection. Again, there does not appear to have been any specific underlying disease, though Vesalius wrote that the youth had "a very white and smooth skin and [was] naturally not at all melancholic [in temperament]." Vesalius discovered from a French priest in the foreigners' hostel that there was water under the skin of the dead man and that the spleen was white but small.(26) Vesalius intended perhaps to make an implied connection between melancholy and the spleen, for the colour and size of the spleen in the youth would correspond with the lack of melancholy in his temperament.

Nevertheless, the causal connection between the condition of the spleen and the illness that might have been

present in the corpse is never fully worked out by Vesalius^s but left as a vague implication. This is indicative, I think, of Vesalius's incapacity, or more probably, disinclination, to develop the theoretical consequences of his observations. To have done so would have ensured some original thinking on his part; for as his observations were his own or contemporary, the explanations for those observations should also have been his own. This is not being unfair to Vesalius; because by not using old explanations for novel observations, as did some of his successors, Vesalius was conceding the necessity for new theoretical ideas at some time in the future.

Vesalius closed the avowedly anatomical part of the chapter with a description of the veins, arteries and nerves leading to the spleen. However, Vesalius made some of his most important anatomical remarks concerning the veins leading to the spleen in the section of the chapter devoted to the function of the spleen. Again, this emphasises the interconnection between observation and function; so that Vesalius's comment at the end of the anatomical section:-

"and this is the enumeration of the situation, shape and parts of the spleen," (27)

should not be taken to reflect a real divorce in his mind between anatomy and function.

The relationship between the function of the spleen and its anatomical description becomes stronger and more obvious when Vesalius came to discuss the function of the spleen;

for Vesalius used his anatomical findings specifically to test the body of ideas on the function that he was writing about. However, Vesalius did not use the relationship of anatomy and function in a synthetic way; that is, to create any new theory of the physiology of the spleen.

In the opening of his discussion of the functions of the spleen, Vesalius repeated the theme of doubt which runs through the chapter, but this time he did so in a more general context. He wrote that the architect of our body had justly ordered those things of which he will teach the use and function, concerning which "not only the chief doctors but the leading philosophers disagree." (28)

The reference to philosophers reflects the disagreement between the position of Aristotle and Galen concerning the function of the spleen. This became a bitter bone of contention amongst their followers in the sixteenth century so that Harvey was to comment that

"The physicians differ in that they speak of the juice of black bile. They are servants of Galen and falsely suppose their belief to derive from Hippocrates." (29)

Vesalius went on to give what is essentially an exposition of the opinions of the ancients and of his contemporaries concerning the function of the spleen, interspersed with his own observations throwing doubt on these views. He repeated the idea of Aristotle that the spleen was a counterfeit liver and then wrote:-

"In the same way the author of the book 'On the Use of Respiration' which they wrongly

attribute to Galen, claims, besides other trash - for example concerning the veins which he testifies are inserted in the gibbosity of the spleen - that the spleen receives the perfected juice from the stomach and intestines through the veins of the stomach and intestines and, in fact, asserts that [it is] an organ of sanguinification. Whose opinion some of the medical doctors also subscribe to . . . "(30)

From the reference to 'trash' it appears that Vesalius was not at all well disposed towards the De Utilitate Respirationis. Galen's theory of the function of the spleen was not treated any more gently by Vesalius, indeed his criticisms have more force in that he descended to details. He wrote that "it seems more probable to the other professors of dissection" that the spleen "is the receptacle of dirty and faeculent blood perfected in the liver; just as the gall bladder reforms the thinner and lighter residue so the spleen is created for taking charge of the grosser and heavier." (31)

From the way that Vesalius described the opinion of the 'professors of dissection' it is clear that it is the orthodox Galenic view-point that is being repeated. Vesalius continued his exposition and stated that it was believed that the spleen was connected by many venous branches to the trunk of the vena cava and through these drew the heavier residue of the liver to itself. It was as if the spleen "attracts and sucks to itself like matter"; it then "perfects, elaborates and restores" the attracted residue so that it was suitable for its nutrition. If the residue was heavy and faeculent the spleen made it into rare and sponge-like blood. (32) It was the transformation of this residue that posed the first problem for Vesalius; he wrote that:-

" . . . the numerous arteries inserted into the spleen especially help, aiding energetically by their heat towards the precise elaboration of that blood. But I doubt that it is clear that the primary and chief agent of this action is the flesh of the liver, even if this [statement] is not to be denied [outright]." (33)

The ground for Vesalius's doubt had been prepared by his question concerning the vascular nature of the substance of the spleen. In Galen's theory, although the heat of the arteries helped, it was the flesh of the spleen itself which assimilated and changed the material that it attracted. Having doubted Galen's opinion that the spleen was vascular, Vesalius was logical in doubting the function ascribed to the substance of the spleen; for if a certain type of substance performs a particular function, when the nature of the substance is found to be different or questioned then the original function ascribed to it ought to be re-examined.

There is an instructive dichotomy in the writing of Vesalius when he made apparent his uncertainty about the transformation of melancholy. A modern scientist who believed in the testing of theories would approve of Vesalius's doubting not only an anatomical statement but also its corresponding functional explanation. The modern scientist would not just doubt a particular section of the theory of which the observation was part, since he might well begin to consider whether the theory in general was invalidated. However, Vesalius could not, and perhaps positively did not want to question Galen's general theory, in which the spleen's alteration of melancholy was a particular instance.

I have described how in Galen's theory every organ changed and assimilated to its own nature the material that it attracted and used for food. When Vesalius questioned how the faeculent residue from the liver was changed into food for the spleen, he could have gone on to doubt Galen's general theory which lay behind the particular function of the spleen that he doubted; however, he did not do this. Nor did Vesalius state that the capacity of the spleen to effect this change could in principle be questioned. Vesalius never expressed himself in this way - his question marks are very limited in scope - and it would have been difficult for him to have done so.

Galen's general theory of digestion was very qualitative. It employed terms like 'presentation', 'alteration' and 'assimilation' without describing in anatomical detail the physical mechanisms by means of which these processes were actually realised in the body. Therefore Vesalius could not use his exact knowledge of anatomy to examine Galen's theory of digestion. Even in cases where Galen did give some details as in his statement that food was concocted and altered by the heat of the stomach and the surrounding vessels, the description is so general that it gave no scope for the minute concentration on detail in which Vesalius excelled.

However, there is another reason why Vesalius would not have questioned one of Galen's general and fundamental theories. The notion that the basic explanatory ideas concerning the body had already been thought out by the ancients

and therefore did not need examining afresh was, I believe, a very powerful factor in the minds of sixteenth century medical writers, including Vesalius. In the second part of the thesis I shall show how this idea was explicitly developed but at this stage it is no more than a hypothesis. It does, however, make the work of Vesalius on the spleen understandable and helps to explain why he did not feel that it was necessary to look into the general theories whose specific details he was questioning.

When Vesalius discussed what happened to the residues from the spleen's alteration of the gross waste coming from the liver we find the most striking example of his doubt and of its limitations. Vesalius wrote that

"it has been granted by everyone that the spleen does not perfect all the blood it admits from the liver and attracts by its innate power . . . "

He continued by explaining that whatever was unsuitable for the nutrition of the spleen and could not be adapted to its substance was disgorged into the stomach.⁽³⁴⁾ Although everyone was agreed on this, the way in which the material was transmitted to the stomach was subject to debate:-

"For in the first place all affirm that the melancholic juice is thrown up from the spleen into the stomach, some [supposing it is done] by a vein reaching from the spleen into the stomach, others by a certain peculiar passage, and then [all agree] it goes from the stomach to the intestine and thence is purged from the body with the faeces."⁽³⁵⁾

At this point a certain amount of irony begins to creep into the writing of Vesalius; for his own anatomical

observations had led him to disbelieve in the possibility of such a connection between the spleen and stomach. His irony was reserved for those who gave specific anatomical details in order to prove their point rather than for those who made a vague assertion:-

"Moreover some write that that vein, or as others please, that passage is simply led into the stomach from the spleen: others boldly specifying the place of insertion, turn their mind towards it being implanted in the upper cardiac orifice of the stomach" [My italics] (36)

Vesalius wrote that some thought that the melancholic juice was "useful and friendly for the functions of the stomach", others related the nature of black bile to its taste "which they reveal to be harsh and sour." However, it was agreed that it:-

"strengthens all the functions of the stomach, which involve some kind of squeezing action, by tightening and drawing [its walls] together, and consequently preventing the food escaping unperfected from the stomach." (37)

Vesalius came back to those who believed that a vein from the spleen was inserted into the cardiac orifice of the stomach and who also stressed the appetitive function of the melancholic juice; He wrote:-

"Others, however, not agreeing with this use however important, add to those uses aforesaid that the appetitive faculty of the stomach is so excited by this excrement that they suppose a vein or channel from the spleen to be inserted into the upper mouth of the stomach chiefly for the sake of this [appetitive] function, thus taught not by dissection but only by fancy. I, of course, dare affirm nothing concerning this eructation of the residue of the spleen into the stomach and of its use. Nor, also, does dissection clearly reveal to me that which professors of anatomy assert boldly and categorically." [My italics] (38)

Vesalius is stating here that for the sake of a pre-conceived idea of the function of the spleen a communicating vessel between spleen and stomach has been imagined, or if one bears in mind Vesalius's comment about the professors of anatomy, has been fabricated. In fact, a vessel (the vas breve) connecting the spleen to the stomach was described by Charles Estienne in De Dissectione Partium Corporis published in 1545⁽³⁹⁾ but probably written before the Fabrica. Therefore Vesalius's irony was a little misplaced but his attitude to the testing of a functional idea is again brought out. It is interesting to note that his irony is reserved for the functional idea which depends upon specific anatomical detail and which he can test by his own observations. In those cases where Vesalius wrote about ideas of physiological function which were devoid of anatomical references, as in the views of the effect of melancholy in the stomach, he makes no comment either way. This difference in his attitude to these two types of functional theory lends support to my view that in Vesalius there existed a disinclination to criticise and think afresh the basic a priori theoretical ideas of the ancients. If the last chapter is borne in mind then the overwhelming influence of Galen upon the physiological ideas that Vesalius discussed should be very apparent. Apart from the Aristotelean alternative the whole of Vesalius's exposition of the spleen's function is based upon Galen. The same also can be said of Fernel but the crucial difference between Fernel and Vesalius is that

Fernel repeated Galen's views as if they were completely true and he did not differentiate between Galen's opinions and his own - in fact it is difficult to separate the two. Vesalius, on the other hand, clearly distinguished his own opinions from those that he was relating, and this gives an altogether more critical air to his writing. Nevertheless, for Vesalius the only way that Galen could be "lawfully doubted" was by the evidence of his own eyes. Vesalius did not attempt to doubt those ideas of Galen which had been produced solely by the mind, nor did he attempt to use his own mind to create the a priori type of theory which I have shown to be the basis of Galen's formulation of the function and nature of the spleen and black bile.

Vesalius did not always adopt so rigid a position concerning the Aristotelean view of the spleen's function as he appears to do in the chapter on the spleen. In the Epistle on the China Root (1546) he described how, when he was in Pisa in 1544, the jurist Marcantonio Belloarmato died.⁽⁴⁰⁾ Vesalius, after his afternoon's lecture, met Belloarmato in a bookshop and the jurist talked about his health and said he would come to Vesalius's lecture the next day so that he could look at the gall bladder, liver and spleen as they were the organs that might be producing his ill-health. However, Belloarmato suddenly died that evening and as the family wished the body to be transported to Siena they requested a surgeon to remove the internal organs. Vesalius wrote that

"I very much wished to know the cause of the sudden and unexpected death of so distinguished a man, I examined [his] spleen which undoubtedly had long functioned in place of his liver."

In the detailed report of the dissection Vesalius did not elaborate further on how the spleen acted in place of the liver, instead he concentrated on the state of the body and the immediate cause of death - rupture of the portal vein. However, it is obvious that Belloarmato's liver was in poor shape and Vesalius thought that the spleen had taken over its blood-making function. In effect Vesalius modified Aristotle's assertion that the spleen could produce blood.

Vesalius reported a similar case, when as O'Malley writes,

"Upon the completion of his lectures in Pisa, Vesalius travelled on to Florence where he had an opportunity to perform another post mortem examination which revealed cholelithiasis, biliary cirrhosis of the liver, and finally rupture of a huge gall bladder into the stomach."

The results of Vesalius's dissection included the idea that the spleen could make blood:-

"Death was primarily due to the transmission of bile into the stomach, which was swollen with bile; also to the hardening of the liver and its contraction or thickening, into one mass, although the spleen was softer and larger than normal and seemed to have served for the preparation of blood; the gall bladder was as large as two fists . . . "

Again, Vesalius did not give any detailed explanation of how the spleen made blood. It does, however, seem to have been on observational grounds that Vesalius based his conclusion. Vesalius wrote that the body that he dissected

in Florence had been that of "Prospero Martello, a Florentine patrician who had suffered many years from jaundice, and like Belloarmato had died a sudden and unexpected death." There are certain important similarities between the cases. Both Belloarmato and Martello had diseased livers and reasonably normal spleens and both had suffered from ill-health for a long time. Vesalius must have drawn the inference that the livers of both men had been malfunctioning, and not making blood for a similarly long time; he had to explain therefore how the body of each man had been supplied with blood and allowed to live. The Aristotelean idea of the spleen's function supplied Vesalius with a ready answer. I think that it was the course of the disease and his observations during the post mortem that made Vesalius think of the spleen as a haematopoietic organ, rather than any general belief in the principle that the spleen made blood. There is, thus, a correspondence in Vesalius's approach to the spleen in the Fabrica and in these two case reports; for there is the same use of theoretical statements which seem to Vesalius to be essentially observational.

Late in his life Vesalius summarised his position on the function of the spleen. Gabriele Fallopio (1523-1562) who held Vesalius's old chair at Padua wrote a running commentary on the Fabrica which he published in 1562 as the Observationes Anatomicae. He wrote that from his own experience he was satisfied with Vesalius's account of the spleen and added that he had seen in Padua a corpse with a

triple spleen which he went on to describe in detail. (41)

Vesalius replied to Fallopio with Examen (1562) and he wrote about the spleen:-

"As for the function of the spleen (unless it too is suited for making blood) I have up to now entertained various opinions; but there is no need to write of this, since you have not dignified it with an observation." (42)

This a good reflection of Vesalius's position, for although in the Fabrica he had rejected the Aristotelean view, he had also doubted Galen's theory and in his case reports he showed that he thought of the possibility that the spleen was a blood-making organ. Again, it is interesting that Vesalius's possible opinion of the spleen's function is not his own. In some of Vesalius's successors the attitude that to produce an alternative theory from the writings of the ancients was as good as creating original ideas becomes very apparent. However, the hesitation with which Vesalius approached the question of the spleen's function shows that in him this attitude is only slightly in evidence. In fact, part of his achievement is his refusal to go beyond testing and questioning physiological ideas and to develop permutations of classical theories which would have been consonant with his observations.

The overall impression produced by the writings of Vesalius on the spleen is of a great emphasis on observation. The theories of the ancients were not questioned by Vesalius except in those cases where his observations contradicted the anatomical details that formed part of the theories -

but these were limited in scope. I have shown that the basis of the physiological section of Galen's theory of the spleen and black bile was essentially a priori and thought out without inference from prior anatomical data. This type of argument is conspicuously absent in Vesalius; the only resemblance to it is his very tentative substitution of Aristotle's view of the function of the spleen for Galen's. However, the essential element of original a priori thinking is lacking. Although I have mentioned that Vesalius can be distinguished from some of his successors by the fact that he did not try to resolve his doubts by drawing upon old answers, the fact remains that Vesalius shared with his contemporaries a common approach to knowledge. The senses could be used to discover new knowledge; the mind lay dormant and created no ideas of its own but instead relied on the mind-created knowledge of the ancients.

Some contemporaries and successors to Vesalius

The first major development in ideas about the spleen, occurring after the publication of the Fabrica was long delayed. This was not any radical discovery concerning the spleen or black bile but was rather an attachment of increased importance to the Aristotelean idea of the spleen as a blood-making organ. The publication of De Liene Libellus in 1578 by Franciscus Ulmus marked the decisive point for the acceptance of Aristotle's opinion of the spleen's

function. Even after this not all anatomists followed Aristotle. Until the De Liene Libellus the writings of the anatomists are generally rather stunted and sparse concerning the function of the spleen.

Realdo Colombo (1515-1559), with whom Vesalius bitterly quarreled, added nothing about the spleen in the De Re Anatomica (1559),⁽⁴³⁾ to what Vesalius had written in the Fabrica. However, the Spaniard, Juan Valverde de Hamusco, whose Historia del Cuerpo Humano (1556) was translated into Latin by Colombo, did make an interesting anatomical observation. He demonstrated that there was a communicating vessel between the spleen and the stomach through which blood could flow. Valverde wrote that a vein inserted into the highest branch of the splenic veins a little before it touched the spleen was led

"through the left side of the stomach
running out almost right up to its own opening"
[i.e. the cardiac orifice] (44)

The vein that Valverde saw must have been one of the gastric veins, in other words, the vas breve. Valverde went on to describe how he had demonstrated the link between spleen and stomach. He wrote, after describing the course of the vas breve to the cardiac orifice:-

"This [connection] was disclosed at Rome . . .
in [the body of] Cardinal Cibono which was
dissected after he had passed away following
a vomit of blood" (45)

It was whilst he was trying to track down the places from which the blood had been lost that Valverde saw the proof of the connection between spleen and stomach:-

"We were squeezing the stomach and immediately the spleen grew swollen, and conversely the spleen being squeezed, the stomach was observed to swell up markedly with blood no doubt through such a vein which was of a noteworthy size and it ascended nearly to the mouth of the stomach." (46)

Valverde went on to give further details of the vascular anatomy of the area around the spleen. His description of the vas breve was contained in a chapter entitled 'On the origin and distribution of the vena porta'. It is possible, therefore, that Valverde, because he was concerned solely with the distribution of the veins, did not mention that his demonstration of the connection between spleen and stomach was important for resolving Vesalius's doubt concerning the spleen's function in aiding the digestion of the stomach.

However, this is not the only reason; for there can be no doubt that, in the case of the spleen, it was observation of its anatomy and not discussion of its function which interested Valverde. In his chapter on the spleen he devoted one sentence to its function:-

"The function of the spleen is to purge the blood from the melancholic juice" (47)

The poverty of Valverde's contribution to ideas on the spleen's function is not really surprising. Vesalius had made observational anatomy the new and dynamic part of medical science, but at the same time he had not re-thought Galen's basic ideas. Valverde, whose Historia de la Composition del Cuerpo Humano is a second-rate attempt to follow the path of the Fabrica⁽⁴⁸⁾ could not be expected to enter an area which Vesalius had ignored. It is interesting,

however, to note the contrast between Valverde and Vesalius. Vesalius did attempt to relate his observations to those parts of Galen's physiological theory which depended on them, while Valverde, when making an observational demonstration which bore directly on the function of the spleen, completely ignored the connection between his observations and the theory that explained what he was seeing. In Valverde, the basic explanatory ideas of the ancients lay even more fallow and unquestioned than in Vesalius.

There were various other writers who gave a cursory glance at the function of the spleen. Jean Tagault, who was elected dean of the faculty of medicine at Paris in 1534 whilst Vesalius was a student there, was famous for his writing on surgery. Caspar Hofmann cited⁽⁴⁹⁾ Tagault's De Institutione Chirurgica of 1543 when in 1614 he wanted to prove that the spleen was essential for life, and that when injured a fatal result could ensue. Tagault wrote that:-

"Wounds of the spleen are dangerous, since it [the spleen] is especially useful and nearly indispensable and has a duty for the whole body, and is (as some have said) like another liver."⁽⁵⁰⁾

Tagault did not elaborate further on the idea that the spleen could be like another liver, instead he went on to discuss the various types of wounds that the spleen could suffer and their degrees of danger. It is clear that the idea of the spleen's blood-making function was current amongst the medical world but at this time it seems to have excited little comment, for Tagault is as brief as Vesalius was to be in the Examen.

Volcher Coiter (1534-1600) was nearly as short-winded as Tagault though more Galenic and orthodox. Coiter was a pupil of Fallopius, Eustachius and Aldrovandi and is best known for his work on the formation of bones and on the comparative osteology of animals. In 1572 he published his Externarum et Internarum Principalium Humani Corporis ^{Tabulae} in which he gave 'Tables of the Parts' which not only described the anatomy of the parts of the body but also their functions. The sections on the spleen are brief and to the point. In the Table entitled 'General tables concerning the nutritional parts' (51) Coiter divided the organs of the abdomen into two categories: those 'destined for nutrition' and those 'serving generation'. The parts for nutrition were then subdivided into those producing chyle, those which made blood and those protecting the parts as the peritoneum, omentum and pancreas. The blood making parts were separated by Coiter into those 'destined' for the best type of nutriment and those for the excrements of blood. The tables for the latter were:-

		The gall bladder drawing bile
	Purge the blood of which there are three:	<u>The spleen sucking out the melancholy humour</u>
		The kidneys, which draw out the watery humour from the blood
(Certain parts are destined) "for the excrements of blood of which <u>some</u> :	Lead away the superfluities of blood to the proper receptacles of excrements They are:	<u>The vena porta to the spleen</u>
		The biliary channel to the gall bladder
		The ureters bringing down urine from the kidneys to the bladder
		<u>The spleen</u>
	Remove the filthy dregs of blood as:	The gall bladder
		The bladder

In these brief headings Coiter gave a succinct resume of Galen's teaching concerning the expulsion of urine, yellow bile and black bile. The format in which the Externarum et Internarum Principalium Humani Corporis ^{Tabulae} was written partly explains why Coiter did not voice any doubts or give any alternatives. ~~Also, if one is trying to give an account of the principles of the human body, it would defeat the purpose of the exercise if doubts about the principles were voiced, for it is in the nature of principles that no question be entertained about them.~~ In the next Table Coiter ~~confirms~~ ^{if} this impression. ~~He~~ explained how he had set out ~~the Table:~~

"Concerning the nutritive parts we shall begin by describing those which present themselves first in anatomical procedure." (52)

He gave some details of the anatomy of organs like the liver and kidneys but with regard to their function he was as brief as he was about the spleen:-

"The spleen designed for cleansing the muddy and melancholic blood, it is called in Greek σπλην, in Latin lien and splen. Its flesh is also called παρέρχουμα. The specific names of its other parts are not of any consequence." (53)

Tagault, Valverde and even Vesalius when he was making a positive statement, share with Coiter his very brief and almost curt manner of writing about the spleen. I think that the title of Coiter's work helps to explain why this should be so. Unlike other anatomists Coiter did not hide the fact that anatomy is explained by principles but rather he emphasised this. The division between anatomy and explanatory principles is apparent also in Coiter's writing; for

instance, he described in detail Eustachius's discoveries concerning the kidneys but wrote very briefly about their function.⁽⁵⁴⁾ Coiter's purpose was to give the student a ready reference to the basic functions of the parts and some knowledge of their anatomy. If one forgets about Vesalius's testing of functional ideas by his observations and one tries to collect together all explicit statements of function to be found in each anatomy book they would not much exceed Coiter's brief summaries. This, I feel, supports my view that the basic explanatory ideas of the ancients were in a sense considered to be static and unchanging; for what was thought to be capable of change produced lengthy discussion, debate and investigation, but this was not the case with the fundamental, a priori, views of men like Galen.

In the next chapter I shall describe how anatomists did begin to change Galen's basic ideas, but this, as I shall show, was not by original and new thinking. However, up to the time of Ulmus, one is faced with the fact that the phenomena of the body were being continually observed afresh without there being any desire to question the body of ideas that gave to the sixteenth century anatomists the explanations of what they saw.

CHAPTER III

THE EXPLORATION OF FUNCTION 1578-1641

The period from the publication of the De Liene Libellus of Franciscus Ulmus in 1578 to the De Usu Lienis of Caspar Hoffmann in 1615 marks a shift from a Galenic to an Aristotelean conception of the function of the spleen. In the period before 1578, the alterations to the Galenic account of the spleen were either observational in nature, or, if conceptual, not discussed at any great length. After Ulmus published the De Liene Libellus the argument about the function of the spleen developed around non-observational, theoretical ideas. It will become clear that even when new ideas were produced, the nature of those ideas did not differ in essence from those advanced by the classical authorities. Furthermore, the tendency to look with suspicion at innovation in the field of basic theoretical knowledge is evidenced by the fact that the more novel ideas of Ulmus were rejected or modified by the anatomists that followed him so that the new theory of the function of the spleen was not as radical as it appeared originally that it would become.

The De Liene Libellus

The work entitled De Liene Libellus which was published in 1578 by an obscure⁽¹⁾ doctor from Poitiers named Franciscus Ulmus commenced the serious debate about the function

of the spleen. The De Liene Libellus bears some resemblance to another innovatory work, the De Motu Cordis of William Harvey. Like Harvey's work, the De Liene Libellus is in the form of a long article or short monograph and conspicuously lacks the large number of citations to ancient texts which were usual in medical writing. Both Harvey and Ulmus were more concerned with developing their respective theories than with giving a scholarly exposition of past and present knowledge, with their own views merely components in the total picture. However, the similarity of the De Liene Libellus with the De Motu Cordis lies only in the form and not in the content. One way of understanding the difference would be to say that for the development of renaissance ideas about the human body both the De Libellus Liene and the De Motu Cordis were important signposts, but that for the development of the rational history of the growth of biological knowledge only the De Motu Cordis was significant. Why this was so should become clear during the course of my examination of the De Liene Libellus.

Although Ulmus's work had no chapters or formal divisions, it can be divided into three parts. Ulmus began by giving an exposition of the opinions of previous authorities concerning the spleen and then refuting each one in turn. At the end of this dismissal of the ancients, Ulmus produced his own solution to the problem of the function of the spleen: that the spleen prepared and concocted the arterial blood necessary for the vital spirits. The middle of the book

contains a long digression on the way the vital spirits are produced and in the last part of the work, Ulmus comes back to the function of the spleen in making blood which would then go to the left ventricle of the heart and there be perfectly concocted by the heart and mixed with air.

In the dedication, to Ioannus Memetellus, Ulmus recounted how his interest in the spleen had been aroused:-

"In previous years, most distinguished sir, when I publicly taught anatomy and amongst the other parts of the body I observed the fabric of the spleen more attentively, I could not be persuaded not to suspect some other use for that viscus than that commonly supposed. The doubt about the same matter of the great Vesalius increased this suspicion of mine. Therefore I immediately undertook to ponder within myself [mecum cogitare], as I am accustomed to do when something is of doubt in the mind, and to investigate the matter itself a little more diligently." (2)

Although Ulmus mentioned Vesalius, his approach is in direct contrast to that of Vesalius who was unwilling to go beyond observation and refused to speculate for Ulmus was prepared to advance hypotheses. Yet, although Ulmus displayed a great deal more originality than his contemporaries, indeed Laurentius was to call his opinion 'new and unheard of', he was still controlled by the broad patterns of thinking established by the ancients. A sign of this is the acceptance by Ulmus of the criteria established by Galen, of what constituted acceptable scientific ideas.

Ulmus began the actual text of the De Liene Libellus by writing that:-

"There have been five opinions concerning the use of the spleen. First, Hippocrates wrote

that the duty of the spleen in the body was to attract from the stomach the water that is in the food even as bile is drawn from the liver to the bladder next to it . . . "(3)

The other views of the spleen's function that Ulmus set out were those of Aristotle, of Erasistratus, of the followers of Erasistratus and those of Galen. Although Ulmus was reasonably accurate when he described the ideas of Hippocrates, Erasistratus and Galen, his account was less complete when he came to Aristotle.

Aristotle's opinion that the spleen helped to make blood and that it was like an adulterated liver was close to Ulmus's view that the spleen prepared the arterial blood before it went to the left ventricle of the heart. Ulmus differed from Aristotle in distinguishing between venous and arterial blood, the former being made by the liver and the latter by the spleen, whilst Aristotle had not defined what sort of blood was made by the spleen. Nevertheless, Ulmus did agree with Aristotle in thinking of the spleen as a blood-making organ. However, Ulmus did not mention this opinion of Aristotle's for he wrote that

"Aristotle seems to have been the originator of another opinion since he, turning a little from his teacher [Hippocrates] thought that the spleen was made by nature in order to divert and attract out of the stomach the superfluous and excrementitious vapour produced from excess drink, which presently it digests. The reason for this is he says, that in those animals that drink a lot (which are of the sorts having lungs with blood) [the spleen] is large and moist; whereas in those that drink little (which are of the kinds having bloodless fistulous and fungoid lungs) it is neither large nor so noteworthy . . . And he adds that on account of this the spleen is necessary per accidens just like the bowel and the bladder." (4)

This is certainly in Aristotle⁽⁵⁾ but comes from his studies of the comparative anatomy of animals and it does not reflect his ideas concerning the specific function of the spleen in man. The omission by Ulmus of this part of Aristotle's writing on the spleen should make one wary of accepting the claims of Ulmus as to his originality.

Ulmus did mention that the spleen had been thought of as another liver, but he ascribed this opinion to an anonymous modern writer. When Ulmus described the opinion of Erasistratus and his successors he wrote:-

"Erasistratus then followed, who, as Galen says, maintained that the spleen was made in vain by nature.

The Erasistrateans condemning the carelessness of this teacher (as Galen relates) said that the spleen in animals was assigned by nature so that it might prepare for the liver the chyle from the food towards the generation of useful blood. One of the moderns copied this opinion; he said that the spleen is the other liver." (6)

As Ulmus knew of Vesalius's doubts about the function of the spleen, he presumably had read the chapter on the spleen in the Fabrica where Vesalius explicitly related Aristotle's opinion that the spleen was a sort of adulterated liver. If, on the other hand, Ulmus had not read the Fabrica but was referring to the Examen where Vesalius had tentatively suggested that his own opinion of the spleen's function was that it made blood, then the 'modern writer' could have been Vesalius. Whatever is the case, it is interesting that Ulmus was unwilling to name either Aristotle or Vesalius as the author of an opinion bearing some similarity to his own, contenting himself with ascribing it as an obscure modern

offshoot of an opinion of the Erasistrateans. Not only is it possible to believe that Ulmus tried to increase his originality in this way, but it is also possible to see in his juggling with ideas a conception of knowledge in which opinions form disembodied entities with a life of their own. When Ulmus recounted the opinions of the ancients it is as if a theological controversy is being related. In theology, there is no reference to observable phenomena which will provide criteria for verification, so also in the ideas of the ancients being discussed by Ulmus there is sometimes no such criteria. This is not always the case, for, as I shall show, the arguments that Ulmus used depended in some instances upon observation of anatomical structure.

Although Ulmus replied to Hippocrates, Aristotle and Erasistratus in turn, it was Galen whom he had to attack most strongly if his own views were to be accepted. After Ulmus had described the opinion of the Erasistrateans and of the 'modern writer' he continued:-

"Finally Galen, whom all successively followed, [and] not only the Greeks but the Arabs, asserted that the duty of the spleen is to attract to itself the thick, faeculent and melancholic blood separated from the perfected blood in the liver, and [asserted] that the blood is cleansed by it even as the bladder under the liver attracts the yellow bile. Moreover he supports this his opinion with six reasons altogether of which the first is this . . ." (7)

The six reasons gave a tolerably accurate account of the basic points of Galen's theory and included both the arguments based upon disease symptoms and upon a priori considerations which I discussed in chapter one.

Ulmus replied to the views of Galen and the other authorities point by point excepting the modern writer whom he ignored. Ulmus employed the Galenic idea that there was an analogy between the food of an organ and the organ itself to attack specific aspects of Aristotle's and Galen's theory. He wrote that Aristotle's opinion was:-

"In the first place false because the substance of the spleen which is fed by vapour is not vaporous; however, every single [organ] is nourished by something similar." (8)

In the same way, Ulmus rejected Galen's teaching that the spleen fed upon melancholy. Ulmus wrote that the spleen did not attract the dirt of the blood because, since the constitution of that organ was rare, soft and loose, so it would need a thin food rather than a thick one such as melancholy. He concluded if there should always be analogy between the food and what was feeding, "as truly there should be", then the similar ought to be fed by the similar. (9)

In a sense Ulmus used Galen against Galen; the element of originality did not lie in his finding a new argument, but in his technical skill in selecting a general idea which, when juxtaposed with the particular teaching of Galen, could be seen as producing a contradiction. The analogy with the dialectician is strong and as with dialectics the sterile attitude to knowledge is apparent in Ulmus's refutation of the authorities. Instead of denying the validity of their opinions with arguments that he himself had created, Ulmus showed the contradictions of the ancients in terms of their

own theories. Again, the view is strongly implied that the ideas of the Greeks were entities in their own right which could be fitted together or taken apart without the need for external criteria of reference.

Another attempt to attack the internal coherence of Galen's theory was made by Ulmus when he wrote:-

I like to parry the fourth argument in this way. If, says Galen, there are contained in the body four humours, nature prepared some instrument for drawing the melancholic humour. I [say], in fact: If four humours are contained in the body, nature [should have provided] some [instrument] for drawing the phlegmatic humour."⁽¹⁰⁾

By pointing out that there was no organ that attracted phlegm, Ulmus showed that the principle of uniformity, whereby similar substances necessitated similar processes, could not be invoked in the case of melancholy and the spleen. His refutation of Galen is based on internal contradictions in Galen's own arg^uments. Thus, Ulmus was accepting the framework of thought created by Galen and the Greeks, rejecting some of the details.

Ulmus used two further types of argument in his attempt to refute previous authorities. First he employed new anatomical discoveries to show that some of the anatomical conditions necessitated by Galen's theory could not be fulfilled. Thus, discussing the Galenic idea that melancholy helped the stomach, he wrote:-

" . . . I may overlook, meanwhile, the profitless nonsensical use of this juice imagined by Galen namely that it excites the appetite. In which a twofold error is made by him. The first

is that he established another insertion than sense teaches, of the vessels from the spleen into the stomach. For although that vessel which he calls a little vein projects from the body of the spleen, it is not, however, inserted into the upper opening of the stomach (as he says) but a little above the middle of its body, towards the left, from where certain thin branches ascend upward but not right up to the mouth of the stomach." (11)

Ulmus did not acknowledge the source of his information but it is very similar to Valverde's description of the vas breve. He went on to describe the other error of Galen writing that although Galen said that melancholy was bitter and acid he himself had demonstrated that it was not:-

"And if it is acid or bitter it will not the better rouse the appetite, since it does not arrive at the seat of appetite [the large nerves at the cardiac orifice of the stomach described by Galen as the source of appetite] seeing that it would be thus vomited out into the middle space of the stomach to which that vessel called 'little vein' reaches, whence as it is heavy [melancholy] it does not easily ascend into the superior orifice of the stomach where there is established that same seat of appetite." (12)

Ulmus is arguing that it would be anatomically impossible for melancholy to reach the nerves at the cardiac orifice of the stomach, something which could have been verified by his readers. However, his point that once in the stomach the melancholy juice would not have reached the cardiac nerves because of its heaviness was not verifiable in the same way, as melancholy does not exist. It is interesting that Ulmus did not attempt to adduce observational reasons for the heaviness of melancholy - he probably felt no need to do so.

The other type of argument used by Ulmus was also observational. When Ulmus replied to Galen's inference of the

existence of black bile and of the spleen's function from disease phenomena, he flatly contradicted Galen. Observations in humoral pathology were far less liable to independent and consistently uniform interpretation than those in anatomy. The evaluation of disease symptoms in terms of the qualitative explanatory terms of the humours was a very subjective process, and what might appear as a tumour filled with phlegm to one doctor might seem to be a collection of yellow bile to another. Ulmus described Galen's "proof" of the spleen's function, that if the spleen became ill and could not attract the melancholic humour then the colour of the body became darker and melancholic. This Ulmus denied:-

"For in splenetics the blood is usually thin and serous but not muddy and faeculent as Galen supposes melancholy to be." (13)

Ulmus continued that in those who suffered from scirrhus of the spleen the blood also appeared thin and serous.⁽¹⁴⁾ He was here arguing from observation, which would have given his refutation of Galen some substance; for the test of observation had been elevated into a prime instrument of proof by the anatomists, although the differences in the types of observations that could be made had not been discussed at any length.

The impression produced by Ulmus's rejection of previous opinions of the spleen's function is that the distinction between a priori ideas and observation of phenomena was not broken. When Ulmus debated the validity of theoretical statements he was quite willing to discuss them within the

framework in which they had been conceived. This is in contrast to Vesalius's refusal to deal with such ideas when there was no observational evidence to refer to. Ulmus's lack of dissatisfaction with the paucity of observational criteria in Galen's theory, and his implied acceptance of the general way in which Galen had argued meant that he subscribed to a view of knowledge not essentially different from that held by Galen. When Ulmus used anatomical evidence he did so in the manner of the sixteenth century anatomists who felt that man's perception was fallible and could be corrected. However, when arguing about Galen's a priori ideas Ulmus did not just say that Galen was wrong; rather he appealed to a deeper stratum of Galen's thought and by pointing out the contradictions of Galen's details in relation to this more fundamental level of ideas Ulmus tried to reach a 'true' elucidation of Galen.

The New Theory of Ulmus

After Ulmus had rejected Galen and the other authorities to his own satisfaction, he propounded his own theory of the function of the spleen. He argued that the use of the spleen was for the "precoction or preparation of arterial blood" writing:

" . . . it has been known that there is a two-fold substance in the arteries, of which one is from air which retains the name of 'spirit' since it flees from the gaze of the eyes, being understood only by the reason. The other [is] from blood, being equally conspicuous in arterial wounds of the living and the dead." (15)

The spleen prepared the blood and the lungs prepared the inspired air. The air and blood then travelled to the left ventricle of the heart where they were mixed and given their final coction by the heat of the left ventricle, after which they flowed out into the body. Ulmus thus changed the status of the spleen. Instead of being a cleansing organ it now manufactured an essential bodily substance.

Ulmus also discussed the different types of spirits concluding that the vital spirit invigorated all the faculties:

"And for this reason you may rightly call it [~~the spleen~~ ^{heart}], with Argenterius, 'the organ of organs' as Aristotle called the hands. For it is, indeed, the vital heat flowing ceaselessly out of the heart which drives and excites each part to its proper work." (16)

The type of argument that was used by Ulmus to support the new and elevated function of the spleen of helping to make vital spirit is similar to that which he had used to refute his predecessors. He had argued that as the spleen did not possess a cavity it could not attract melancholy, because all organs that attracted excrements had conspicuous cavities. (17) Now, when he wanted to prove that the spleen manufactured blood he again employed the principle that similar structures in the body ought to have similar functions, writing that "the juice from the stomach and intestines attracted through manifest ways to the spleen" is concocted and "a new material is made, exceedingly different from what had been attracted." (18) He was able to support this statement by pointing to the plexus-like nature of the spleen's veins and arteries and

then writing "A similar and equal use appears in the lungs, in the testicles and spermatic vessels, the choroid plexus, the breasts capable of producing milk: in all [of] which nature has made a similar plexus of vessels, because they were to concoct new material." He concluded, "In short there is no part in the body with these evident intertwinings and bendings of the vessels which does not produce a new work and does not make a new form by itself subduing and overcoming the material." From this, Ulmus was able to write that "It will not be absurd therefore . . . if we judge that the spleen [has been] made by nature so that it predigests the arterial blood."⁽¹⁹⁾

The principle of the identity of structure and function is the same in both the argument used by Ulmus to refute Galen and to confirm his own opinion. One characteristic of this principle is that if it is to be applied, then all contradictions have to be removed. Ulmus was in effect saying that if the scheme of the human body was to be devoid of contradiction then it would be quite natural that the spleen should make arterial blood. However, despite the novelty of his view, the scheme within which Ulmus was working was Galen's; for the functions of the lungs, breasts and other plexiform organs with which Ulmus hoped to homologise the spleen had all been set down by Galen.

Ulmus did have to do violence, however, to other parts of the scheme so that he could fit in his own modification. This becomes most apparent when he described how the arterial

blood, once it had been prepared by the spleen, went to the left ventricle of the heart. Ulmus asserted that the blood went from the caeliac artery into the trunk of the aorta and thence into the left ventricle of the heart⁽²⁰⁾ which he had previously stated was "the principal workshop of the vital spirit."⁽²¹⁾ As the De Motu Cordis had not been written, the circulation of the blood was not a problem. Nevertheless, the aortic valve of the heart had been known since the time of Hippocrates and this presented difficulties for Ulmus. He had to explain how the blood could flow into the left ventricle when the valve was closed against it.

First, Ulmus tried to show that a flow of blood into the left ventricle of the heart occurred in the foetus. He wrote that in the foetus the arterial blood was not transmitted through a septum, like that found in the middle of the heart, but went by a very evident path. This, in fact, was to be found in the umbilical arteries and their insertion into the crural arteries of the foetus.⁽²²⁾ Ulmus wrote that:-

"The left ventricle of the heart of the foetus itself attracts the vital and spiritous blood from the maternal uterus through those umbilical arteries." (23)

Ulmus compared the adult to the foetus, and concluded:-

"And therefore in the adult, nature ought to make some manifest way through which the blood may lead through into the aortic artery and the left ventricle of the heart, since the need of vital blood is greater in him [the adult] than in the foetus, on account of its greater dissipation through the hard labours of the body and the brain." (24)

The analogy with the foetus indicated that an upward motion of blood through the aorta to the heart was possible. However, Ulmus had to show that the blood could flow into the heart against the aortic valve. If his analogy with the foetus is less than convincing, his further use of it ~~stret-~~^sretches credulity; and Ulmus himself realised this for he did not rely on the analogy alone, but tried to bring forward other reasons for the possible flow of blood against the valve. He wrote that the 'three forked membranes' (the aortic valve) were not a hindrance:-

"For they did not, whilst the foetus was in the uterus, prevent the blood with the vital spirit from being enticed from the maternal uterus and transmitted into the great artery through the umbilical arteries of the foetus and introduced into the left ventricle of the heart. Should we not rather say that these little membranes are added not in order to bar the way into the heart from the artery but only to reduce the force of the reflux of blood for otherwise the heat which should be supreme in the left ventricle of the heart might be damped down or even stifled; just as we may see a bright fire damped down and so stifled, sometimes, even in a large and crowded pile of logs." (25)

The visual images of logs and light give a concrete reality to the vital heat contained in the left ventricle, but this does not hide the fact that Ulmus was piling ad hoc hypotheses upon each other in order to make his theory plausible. When Laurentius discussed this point he quickly seized upon it as a prime reason for rejecting Ulmus, and anatomists who were more favourably disposed to Ulmus than Laurentius did not attempt to support at any length the contention that blood could flow into the left ventricle of the heart from the aorta.

Ulmus was trying to interpret away the reality of known anatomy for the sake of his theory, and therefore did not differ from Galen. In a sense the approach of Ulmus was a step backwards when one remembers the insistence of Vesalius on the primacy of anatomical observation. The view of knowledge presented by Ulmus is one where a priori theory can do violence to observation of the human body.

Despite his radical innovatory ideas, Ulmus remains firmly rooted into Galenic thought. His book merely presents a change in a detail, albeit an important one, of Galen's teaching. What is significant is that Ulmus took the test of truth to be Galen; for he tried to produce a 'true' Galen devoid of inconsistency, and in doing so accepted the over-all Galenic theory of the body: for by using it to show that certain details were not consistent he implicitly accepted its truth.

Archangelus Piccolomini

Ulmus produced a new theory of the spleen and tried to justify it by showing that it would make Galen's explanatory theory of the body more consistent. After the publication of the De Liene Libellus there was another attempt to achieve consistency, of a totally different kind. Archangelus Piccolomini did not elaborate any new theory of his own, but instead tried to achieve a reconciliation of the views of Aristotle and Galen.

Archangelus Piccolomini was born in Ferrara in 1526 and was Professor of Medicine at Rome; the year of his death is not known, and there is little information to be found about him in biographical reference books.

The Anatomicae Praelectiones published in 1586 is, as the title suggests, a book written in the form of lectures. It was an attempt by Piccolomini to produce a standard reference book in anatomy, while including at the same time some discussions of controversial problems.

Its chapter on the spleen is one of the best examples of an anatomist trying to reconcile ancient authorities. The Aristotelean idea of the spleen's function was widely discussed by 1586. Piccolomini was thus faced with the opposing Galenic and Aristotelean viewpoints, he did not mention Ulmus or his idea that the spleen prepared arterial blood for the vital spirits, and his way out of the quandary was to produce 'solutions' which included both opinions. In Piccolomini, the attitude that the ideas of the ancients could be permuted so that a better 'fit' was produced is again present. Unlike Ulmus, Piccolomini had no new ideas, and his conception of a better rendering of the views of the ancients lay not in terms of the internal consistency of one theory, but rather in reconciling the different opinions of the ancients. Both Ulmus and Piccolomini agree, nevertheless, in their acceptance of the value of the views of the Greeks.

Much of Piccolomini's chapter on the spleen was drawn

from Galen. When there was no conflict between authorities, Piccolomini did not mention Galen as his source but, like Fernel, wrote as if what he was teaching was incontestable truth. When there was disagreement, then the opinions of Galen and those of his adversaries were carefully labelled and distinguished, and it was not until Piccolomini produced his solution that the reader again read 'true' statements. There was no semblance of the rebel in Piccolomini. The influence of Galen was deeply ingrained in him. One can see this in his description of the veins from the spleen to the stomach:-

"They are the other splenic veins which are directed from the spleen itself to the mouth of the stomach, to this end that the thicker portion of the melancholic humour which could be neither softened nor broken down by the power of the spleen; as if it was unfit for nutrition [of the spleen] should be thrown out into the mouth of the stomach by means of its own duct, as if by vomiting." (26)

There is here no hint of doubt or reservation, no reference to the fact that the vas breve went near, but not right up, to the mouth of the stomach. The discovery of the connection between spleen and stomach only made Piccolomini more sure of his belief in Galen's explanation. When Piccolomini discussed further the function of these connecting veins, it is clear that it would have been very difficult for him to have introduced ideas created by himself to take the place of those set down by antiquity. Piccolomini asked:-

"Is this by accident and by chance? This unbroken part of the melancholic humour, since it is harsh and sharp, contracts the stomach and makes it narrow, so that thus all its action

is firmer and stronger. Nor does it only strengthen and make firm the whole mouth of the belly, but, as many say, it is this which raises and revives a slow and dejected appetite . . . Therefore, who will not admire the great forethought of nature which has adapted this most vile excrement for the most noble uses?" (27)

I shall discuss some of the consequences of a belief in a final cause and in the providence of nature in the second part of the thesis. Piccolomini's admiration of nature's foresight is a sign of the difficulties facing anyone who wanted to dispute particular parts of Galen's teaching. In the first chapter, I described how Galen's theory of digestion was an interconnected whole, with the specific functions of the parts being orchestrated by the forethought of nature. If Piccolomini had questioned part of the totality, then the whole edifice could have been brought down. Furthermore, the working of Nature did not have degrees of 'goodness', for it proceeded in the best possible way. When, therefore, the anatomist explained the artistic workmanship of nature, his reasoning either reflected the way in which nature had created man and was therefore absolutely correct, or did not do so, and was therefore completely wrong. The crucial point is that because Aristotle and Galen had seen the workmanship of nature as producing the best possible complete structure and not the best possible individual part, if the anatomist was incorrect in one place, then he would be wrong everywhere. Piccolomini was aware of this; for, when he set down Galen's opinion on the use of the spleen, he repeated Galen's question of whether the spleen acted with forethought,

and his answer was the same as Galen's. Piccolomini wrote:-

"The spleen, therefore, is to be counted also in the number of those parts which are prepared for the convenience of other parts and of the whole body. For if it did not cleanse the blood of this thick refuse like wine-lees, all the parts of the body would be nourished with impure food and thus would soon succumb to a laborious death from this refuse. Because, therefore, it provides a purer nourishment for the other parts, does it share in reason and does providence lead it? Not at all; but in acting differently, both in serving its own ends and in procuring a suitable food for itself out of the natural melancholic juice, it [the spleen] seems to furnish a purer blood for the nourishment of other [parts] Then, is the spleen, in fact, ruled and established by that nature from which every reason and every providence originates? It [the spleen] does not act, therefore, from reason and foresight but it is ruled by that nature which rules, manages and governs all things with supreme reason and supreme foresight." (28) [my italics]

It is obvious that Piccolomini felt that the concept of nature's overall foresight was a ^avalid and necessary part / a of any explanation of the human body. When, therefore, Piccol^omini discussed the disagreement between Galen and Aristotle as to the function of the spleen, he tried to join the two opinions together in such a way that the admiration for nature's providence was increased rather than decreased. Piccolomini first gave a completely orthodox rendering of Galen's teaching on the function of the spleen and then he discussed Aristotle's opinion, writing:-

"I believe also that the second function of the spleen which Aristotle, as I said a little earlier, seems to have introduced, can be admitted: that is that it is of value and has been provided for the making of the blood. This can be plainly understood by that aforesaid distinction. Either the spleen shines and has been endowed with its own

colour, or else with a colour repugnant to its nature. But if it has been endowed with a natural colour and thus with a related constitution, either it obtains as great a mass as nature has prescribed or a much greater, so that it seems to surpass the liver in size, or else there are two or three spleens, as Fallopius that most careful anatomist bears witness to having found. Having set this out, we say: If the spleen is endowed with a natural colour and constitution and is much more remarkable and larger than the liver itself, it can be thought that Aristotle's opinion is true: namely that the spleen has been provided so that it may help the liver in making the blood, especially if the liver is much smaller than the spleen, as they say has been found in not a few cases. For that small size of the liver cannot assist all the parts of the body in refining and making blood and thus it was fair for an assistant to be given to it." (29)

Earlier in the chapter, Piccolomini had written that in the foetus the colour of the spleen was red like that of the liver because the maternal spleen and not the foetal spleen concocted the melancholy humour. However, after birth, the spleen began to perform its function of purging the blood from melancholy and so became dark red in colour tending towards black.⁽³⁰⁾ Thus, Piccolomini was able to insist that the natural colour of the spleen was red, and from the argument of correspondence between function and colour he could conclude in his discussion of Aristotle's views that if the spleen was naturally red like the liver it would have the liver's blood making function. Furthermore, if the spleen was like the liver, then, if it was larger than the liver, the likelihood that the spleen had the same function as the liver appeared to be increased.

Whereas Ulmus used the correspondence between structure and function in different organs to refute part of Galen's theory and to prove the validity of his own ideas, Piccolomini

employed the same principle to show that Aristotle and Galen could be placed together. Piccolomini was able to 'admit' Aristotle's opinion without altering Galen's teaching in any way. However, if his argument for believing Aristotle contains some originality, the way in which Piccolomini tried to answer some of the objections to joining Galen and Aristotle is completely derivative. A major difficulty was that if the spleen was both a blood making and a blood cleansing organ, then there would be occasions when chyle and melancholy were both present in the vein connecting the spleen and stomach; for the chyle would flow from the stomach to the spleen to be made into blood, and melancholy would be ejected from the spleen into the stomach to help digestion and appetite. Piccolomini replied that the blood making function of the spleen:-

" . . . can be even more plainly understood from the resolution of the objections which may be laid against it. For when Aristotle in chapter seven of Book three of his De Partibus Animalium writes that the liver and spleen help towards the digestion of food, because they have a warm nature, Averroes holds the opposite opinion and says as follows in his Paraphrasis de Animalibus. The spleen does not produce blood out of itself; the indication of this is that, a single vein extends from the stomach to the spleen, by means of which the spleen is cleansed of melancholy, but the chyle is not attracted. The following reply can be made to this: that the vein through which the spleen is cleansed of the melancholic humour . . . is the same [vein] through which the chyle is drawn from the stomach to the spleen, just as it is through the same mesaraic veins that the chyle is carried from the intestines to the liver and the blood is carried back from the liver to the intestines which are to be fed." (31)

The 'solution' that Piccolomini produced was not original with him, but merely an assemblage of concepts picked from the treasure-house of ancient ideas. In the Natural Faculties (32)

Galen had carefully stated that a two way flow of chyle and of blood was possible through the same veins. He had relied on the idea that there was a varying power of attraction in each organ and in every part of the body. The force of the attraction would alter according to the changing need of a part. In an absolute sense, an organ like the liver had a greater need for food than the intestines; it was possible, however, that circumstances could arise whereby the intestines would attract the blood from the liver, and the chyle from the intestines to the liver would be stopped. Piccolomini did not spell this out in his solution, for he would have expected his readers to be familiar with the Natural Faculties.

Piccolomini employed Galen's idea of differential attraction to answer a similar objection, namely, how the spleen could send blood towards the liver and at the same time attract the melancholic humour from the spleen. He wrote:-

"When, therefore, the chyle has been in the spleen and has been converted into blood by the spleen, then it is poured out from the spleen through the fourth branch of the vena porta into the liver, so that from there it may be distributed through the roots and branches of the vena cava in every direction into all parts of the body that have to be fed. Neither should it be thought absurd that it should be through the fourth branch of the vena porta that both the natural melancholic juice should be carried down into the spleen and its superfluous blood should be poured from the spleen into the liver, because these parts possess different desires." (33)

Again, Piccolomini did not write that this explanation was derived from Galen. One can only conclude that the idea

of varying attraction was so deeply ingrained that it needed no label. Indeed if Piccolomini had named the author of the idea he would only have raised doubts and given notice of the possibility of human fallibility. When writers like Fernel and Piccolomini set down the views of the ancients without ascribing them to their authors it means that those ideas were no longer endowed with that frailty with which anything created by man is endowed.

After he had cleared up some possible problems, Piccolomini arrived at his inevitable conclusion that the spleen made blood and also cleansed the body of melancholy and that it did this by means of a common action. He stated:-

"The spleen, indeed, by means of the constant and powerful pulsation of the arteries overcomes, wears down and changes into blood the melancholic juice from the liver since the liver cannot overcome and change it. [And also] indeed the chyle from the stomach, which, with the same powers, it changes into blood. Therefore, the function of the spleen will be a double one; the one to cleanse the blood, which is to be distributed to all the parts of that foul and muddy juice, the other to help the liver, when it is of a smaller size in the manufacture of a more plentiful supply of blood." (34) [My italics]

There is no justification for the 'therefore' of Piccolomini's conclusion. He offered no explanation of how Galen's mechanism (the action of the arteries) by which the spleen changed melancholy, could also apply to the manufacture of blood - he merely asserted that this was the case. The assertion gained in force however, by the fact that Piccolomini could give a description (unlabelled 'Galen') of the way in which the spleen did change melancholy. He could always reach

the desired conclusion in a convincing way, if it was seen that the substance^t of the terms of his argument was derived from the a priori knowledge of men like Galen and Aristotle. What was important for Piccolomini was to achieve a convincing reconciliation of Galen and Aristotle, rather than to prove the truth of the ideas themselves. There is, here, a certain similarity with the great Church Doctors of the Middle Ages who were concerned more with assimilating Aristotelean philosophy with Christian doctrine than proving the validity per se of Aristotle's teaching.

Some of the marginal comments in the Anatomicae Prae-lectiones are reminiscent of a medieval Summa. Piccolomini ended his chapter on the spleen by answering possible questions about the spleen, and in the margin are repeated 'Quaestionis solutio' and 'Quaestionis explicatio'.⁽³⁵⁾ The solutions typify Piccolomini's whole approach towards problems of knowledge. An appropriate, though perhaps unfair, way of ending a discussion of Piccolomini's work would be to repeat one of his solutions:-

"Then it can be asked whether the melancholic humour is carried along because it is driven out by the liver or because it is attracted by the spleen. I consider that it reaches the spleen both driven out by the liver, as being a useless burden to it, and also attracted by the spleen as its familiar food. Thus this transmission takes place by means of the concurrence of both, namely the expulsion and attraction." (36)

The easy naivety of the conclusion hides the fact that this again is an example of the consciousness that Piccolomini had of non-observational knowledge. In our eyes, Piccolomini's

answer to the question has practically no content. As he had earlier stated that the melancholic humour was the food of the spleen and that it was inimicable to the liver, Piccolomini could easily conclude that both attraction and expulsion were involved. This is no real conclusion, but merely an explication of the terms of Galen's theory of digestion and attraction. Nevertheless, it was a sufficient answer for Piccolomini; for truth lay in the proper understanding of the views of the ancients and, more generally, in the appropriate fitting together of contrasting opinions.

Andreas Laurentius

Piccolomini's attempt at conflating the teachings of Galen and of Aristotle was not taken up by later writers. Instead the Galenic and Aristotelean positions became more sharply defined with the Aristotelean view apparently in the ascendant by the end of the sixteenth century. The writings of Andreas Laurentius and of Caspar Bauhin exemplify this situation. Laurentius was a die-hard Galenist, whilst Bauhin was influenced by the Aristotelianism of the Paduan medical faculty where he had studied.

André Du Laurens or Laurentius was born in Tarascon in 1558 and died in Paris in 1609. He was a professor at Montpellier between 1586 and 1598, in which year he became a physician to Henri IV and then first physician to Catherine de Medici. He was chiefly noted for his support of Galen

which emerges very strongly in his Apologia pro Galeno published in 1593, and in his Historia Anatomica Humani Corporis of 1595. His support of Galen is also reflected by the university in which he taught, for Montpellier was a stronghold of Galenic thinking.

Laurentius's most famous book was the Historia Anatomica Humani Corporis. It went through various editions and the Latin text was translated into French. I have used Helkiah Crooke's English translation, for Crooke incorporated large sections of the Historia Anatomica into his Μικροσκοπικα (1615) mainly as a corrective to the Aristoteleanism of Caspar Bauhin's Theatrum Anatomicum which formed the substantive part of the Μικροσκοπικα (37)

In the Historia Anatomica Laurentius described the anatomy of particular organs and then wrote separate chapters on the various 'Anatomical Controversies' surrounding his descriptions. Discussion of the controversies about the spleen occupies four folio pages, while the anatomy of the spleen is dealt with in less than one page. This illustrates the extent of the attack against the Galenic position and, conversely, Laurentius's desire to defend Galen.

Most anatomy text books put the function of the spleen last and gave descriptions of the site, figure and size of the organ at the beginning. Laurentius's chapter on the spleen did not, however, contain much descriptive anatomy although marginal notes ('Situs', 'Figura', 'Magnitudo', 'Compositio') suggest longer comments. Indeed, Laurentius

introduced the idea that the spleen cleansed the blood of melancholy in the opening of the chapter. He wrote that just as farmers surrounded their fertile corn fields with fodder-lupins to entice away the bitterness of the earth to make the wheat sweeter, so also nature made the spleen opposite the liver that it might purge the faeculent dirt and thick and muddy juices from the liver and render the blood purer and brighter.⁽³⁸⁾ The rest of the chapter is written in this same way with homely analogies and classical allusions⁽³⁹⁾ serving as vehicles for a faithful and uncritical repetition of Galen's teaching.

In the 'Anatomical Controversies', Laurentius's tone changes from an urbane confidence in the knowledge of the ancients to an anxious acerbity at the impudence of Galen's detractors. Question twenty-five of the Sixth Book of the Historia Anatomica was entitled 'De lienis usu contra Galeni calumniatores',⁽⁴⁰⁾ and this formed the fifteenth Question of the Third Book of the Μικροσκομογραφα. Crooke's translation of the title, 'Concerning the use of the Spleene, against the slanderous calumniations of Galen's Adversaries',⁽⁴¹⁾ is a bit free - he tended to add a few words of his own to Laurentius's defence of Galen - but it expresses the sense of the Latin well enough. Although Laurentius wrote that, "There be divers opinions of the Ancient as Moderne writers about the use of the spleene", his main preoccupation was with the opinion of Ulmus and his treatment of other writers was generally rather cursory.⁽⁴²⁾

The novelty of the De Liene Libellus had been grasped by Laurentius and his description of it shows that he had taken some trouble to understand it. Laurentius began by writing that:-

"Ulmus, a Physitian of Poytiers in France, in an elegant and wittie Booke which hee set out of the Spleene, hath devised a new and uncouth ['inauditum' - unheard of] use thereof, that is, that in the Spleene the Vitall spirite is prepared: hee meant that the thinnest part of the Bloode, which is the matter of the Vitall spirite, passeth from the Spleene through the Arteries into the left ventricle of the heart, where it is mingled with the aire, and perfected and so powred foorth through the arteries, as it were through chanelles and watercourses into the body. And this new paradoxe he establisheth with reasons, which carry a shew of great strength and evidence of truth ["Rationibus satis validis et veri specie (43) quadam adumbratis novum hoc dogma stabilit."]

Crooke's customary desire to add his weight to Galen's defence probably accounts for the translation of 'dogma' as 'paradoxe'. However, the use of 'specie' by Laurentius to describe the effect of Ulmus's reasoning indicates his opinion of the De Liene Libellus. Laurentius gave a very clear synopsis of the De Liene Libellus during ^{the} course of which he repeated two of Ulmus's basic arguments. Laurentius wrote that "we are persuaded . . . hereunto, both by the structure of the Spleene it selfe and by the Symptomes or accidents which follow those that are splenetick." (44) The plexiform structure of the spleen's arteries and the analogy to be drawn with other plexiform organs of concoction - the rete mirabile, the testicles and the liver - was described by Laurentius, as were the symptoms of splenetics which "are demonstrative signs of a languishing or decayed heate and

impure spirits." (45) Laurentius concluded that "The probability of these arguments hath made many to stagger in their resolution concerning this point, and yet notwithstanding if they be called to the touchstone, wee imagine they will prove no current Coine." (46)

Laurentius seized upon the weakest point of the De Liene Libellus and asked:-

"For how may it be that the vitall spirit prepared in the webs of the Spleene [quommodo praeparatus in lienis plexibus vitalis ille spiritus], should be conveyed by the great Artery unto the left Ventricle of the heart, when at his orifice there are three Valves or Membranes shut without and open within which hinder the ingresse of anything into the heart." (47)

It is significant that Laurentius put the anatomical weakness of Ulmus's theory as his first reason for rejecting it. He realised as did every anatomist that the argument which would gain most agreement was that based upon observation. Nevertheless, it is a moot point whether Laurentius would have considered this empirical type of theory-testing as having the greatest persuasive power; for one's suspicion is aroused when Laurentius refers to the golden words of Hippocrates which he used to add force to his reasoning. Having set down the objection posed by the valves of the heart Laurentius continued:-

"And this Hippocrates in his Booke De Corde plainly avoucheth, whose words because they are sweeter than Nectar and brighter than the midday sun we will willingly transcribe [cuius verba, quia sunt quovis nectare suaviora, quovis sole illustriora, libenter ascribam] 'At the mouths or ingate of the Arteries, there are three round Membranes disposed, in their top like a halfe circle . . . neyther water nor winde can passe into the heart: and these Membranes are

more exactly disposed in the mouthes of the left ventricle, and that for very good reason,' Thus farre Hippocrates. From whence I gather if nothing can passe through the Artery into the heart, how shall the bloode attenuated in the Arteries of the spleen passe thereinto as Ulmus conceiteth." (48)

Whether Laurentius used Hippocrates to support or to prove his argument is a debatable question. I believe that Laurentius saw the words of Hippocrates as binding proof; for he did not write that he had observed the valves of the heart and their effects and that others could do the same. If he had done so then the proof of his argument would have lain in the fact that what he had stated could have been independently verified; for Laurentius this was not the highest criterion of proof. The words of Hippocrates not only gave support to his argument, but actually proved that what was being described was indeed true. Vesalius would have used Hippocrates or any other authority as a support, but not as a proof, of any observations that he might have made. The conservatism of Laurentius meant that not only a priori ideas but also observations found their final confirmation in the writings of the ancients.

The remainder of Laurentius's refutation of Ulmus was drawn from the theoretical and a priori teachings of Galen. When Laurentius attacked the way that Ulmus had tried to work his way out of the difficulty presented by the cardiac valves, his argument was based on assertions that could not be verified by observation. Laurentius wrote:-

"But know what the answere will bee, that those Membranes are not altogether to hinder the passage too and fro; but that nothing should

passe or repasse together or at once after a tumultuous manner. But this is idly to decline the force of the argument, for the blood that is brought into the heart for the generation of vitall spirits, must both be abundant, and at once abundantly exhibited unto it; which these semicircular Membranes will not admit." (50)

Ulmus had stated that the amount of blood necessary for the vital spirits need not be great whilst Laurentius asserted that an abundant supply of blood was needed in the heart for the generation of vital spirits. Even though his arguments were weak, Ulmus had tried to support his contention. Laurentius did not bother. In fact, there was no need for Laurentius to have attempted to do so, for, unless the amount of blood necessary could have been directly observed, there was no way of proving how much blood was needed. Therefore one's judgement of the amount necessary would be determined by the terms of the general theory or system in which the concept of vital spirit was included. Ulmus produced his own modifications to Galen's system, and the onus of proof lay with him to support his assertions with fresh reasoning. Laurentius, however, had no such need for new arguments. The general theory explaining the amount of blood required had already been established by Galen and its truth was not doubted by Laurentius.

The more one reads the writing of Laurentius, the more one is aware of a paradox which appears startling at first sight. Laurentius sought to support Galen's system against its detractors, yet his proof of its validity lay in appealing to the system itself. It is as if the existence of Galen's

theories was proof of their truth. Laurentius's opinions were identical in most respects with those of Galen, and, when he tried to support them, he used the same reasoning that Galen had used; in effect this meant that the writings of the ancients were themselves their own validation. Later I shall show that such an attitude was not as paradoxical as it might appear granted the view of knowledge articulated by medical writers.

When Laurentius gave his own opinion of the function of the spleen this situation becomes very apparent. After having answered Ulmus on the symptoms of splenetics, Laurentius wrote:-

"These things being so, let us now lay downe our opinion concerning this use of the spleen. We will [agree] therefore, with Galen, that the spleene is ordayned for the expurgation of foeculent blood, and therefore Nature hath placed it opposite to the Liver . . . " (50)

Laurentius then repeated the Galenic explanation of the spleen's function and ended by writing:-

"and this is the true and uniform opinion of Galen and the most Physicians concerning the use of the spleene, which it shall not be amisse to prove also by some arguments." (51)

Laurentius stated that his opinion was identical to Galen's, and wrote that this could be proved 'by some arguments'; the modern reader might expect the reasons to have been conceived by Laurentius or at least to have been distinct from Galen's teaching. This is not the case, for the three reasons which Laurentius adduced in support of Galen and himself are all derived from Galen. The first reason that

Laurentius employed to confirm Galen's opinion came from the passage in the Natural Faculties ~~De Usu Partium~~, where Galen argued that as melancholy was more noxious than yellow bile and urine it must have a container and the spleen, by elimination, was that container. (52) In the second reason, Laurentius openly used Galen to support Galen. Laurentius wrote:-

"Moreover that the Spleene is ordained for the drawing and purging of the lees of the blood, these things doe sufficiently witnesse, because it is most subiect to obstructions and scirrous tumours, not by reason of his substance, for it is rare and fungous like a fast sponge or a smooth pumic-stone; not by reason of his vessels which are very large: wherefore by reason of the humor contained therein, which if it were thin would nyether beget obstructions nor such scirrous hardnesses. This Galen teacheth in the 13 booke of his Method. 'The substance' sayeth hee 'of the Liver is very liable to the scirrhus, as naturally conteining some myrie and grosse iuyce: the substance of the spleene is more rare and open than that of the Liver, but yet is ofner afflicted with scirrhus tumours, because of a kind of Aliment wherewith it is refreshed.' And againe in his 5 Booke of the 'Faculties of simple medicines. The Spleene hath ample passages.' From whence then proceed these frequent obstructions but from the grosse and foeculent blood?" (53)

Laurentius gave as his third reason the fact that when the spleen was obstructed, then black jaundice occurred, which was the same argument that Galen had developed to prove the existence of black bile and to illustrate the function of the spleen in clearing it away. (54) The rest of the chapter and the other two chapters on the Questions, 'By what wayes the Melancholy iuice passeth from the Spleene to the bottome of the stomache, and for what use', and, 'How those that are splenetick are purged by Urine, and by what wayes those purgations passe', (55) follow similar lines.

The view that Laurentius held of anatomy may have been old-fashioned in its defence of Galen. However, in his willingness to discuss theoretical non-observable issues in biology and medicine he was as typical as the most neoteric Aristotelean writer of the day. The Vesalian emphasis on observational verification of theory has disappeared and Laurentius shares with Bauhin, Spigelius and Hofmann - all Aristoteleans - the ability to place one unverifiable statement on top of another, often as a refutation of a further untestable assertion. Laurentius merely differed in his degree of inflexibility and in his choice of Galen as the ancient authority who could prove his own opinions - which were the same as Galen's. By means of this circularity, Laurentius attempted to show that the controverted details of Galen were consistent with the general theory of the body which Galen had propounded. Ulmus had tried to point out the inconsistencies of certain details with the rest of Galen's theory, and Bauhin was to do the same later on. However, Laurentius, Ulmus and Bauhin all accepted the background of Galen's teaching as being necessary for proving whether the details of Galen were correct or not. In this sense, Galen's overall teaching remains the framework within which certain details can be shown to be true or not - and the result of this is that one does not see any original thinking coming from orthodox medical writers even when they appear, as does Bauhin, to be producing changes.

Caspar Bauhin and the New Orthodox Solution

Caspar Bauhin was one of the first of the able North European anatomists who studied at Padua and who then returned to their own country. Like Caspar Hofmann and William Harvey who both followed his footsteps, Bauhin leant towards Aristotle. All three men exemplify the spread of Aristoteleanism in the medical faculty of Padua, an Aristoteleanism that had been one of the main objects of Laurentius's wrath.

Caspar Bauhin was born in Basle in 1560 and he died in the same city in 1624. He was educated at Basle University, where he received the degree of Bachelor of Philosophy in 1575, and at Padua where he studied under Fabricius ab Aquapendente. In 1581, Bauhin returned to Basle and received his doctorate in the same year. He spent the rest of his life in Basle and held the chair of Greek and the joint chair of anatomy and botany.

Bauhin's most famous book in anatomy was the Theatrum Anatomicum published in 1605, which was widely used and formed the basis of Harvey's Lectures. As Dr. Whitteridge writes, (56) it was, "Bauhin's most celebrated anatomical textbook" and "soon acquired the reputation of being the best anatomical textbook available." In fact, the Theatrum Anatomicum was used by Crooke as the main text for his Μικροσκοπικα although Crooke was rather wary of Bauhin's Aristoteleanism.

The Theatrum Anatomicum was not just a compendious textbook; for Bauhin did give the results of his own research.

Yet there was no single problem to which Bauhin was able to give a totally original solution. The exigencies of catering for university students and their examinations forced Bauhin to supply the teachings of the ancients and of the moderns either in the text or in footnotes. Consequently, although Bauhin was willing to give his own opinion, it always formed a small part of any one chapter. This contrasts with the De Liene Libellus of Ulmus, where one particular problem was extensively examined and the references to authorities were used only in so far as they related to the solution that was to be proposed.

The chapter on the spleen in the Theatrum Anatomicum can be divided into two parts, the one consisting of the views of the authorities, the other being the opinion of Bauhin. The solution that Bauhin proposed for the function of the spleen was followed by most anatomists (Bartholin, Spigelius, Hofmann, Harvey) until the publication of the Syntagma Anatomicum of Vesling^(A) in 1641. Bauhin's work on the spleen came to represent the general consensus of opinion about that organ, and does indeed bear the hallmarks of a consensus solution. This is not surprising, for the Theatrum Anatomicum, in common with most popular and trusted textbooks does not contain extreme or idiosyncratic opinions which would arouse the suspicion of teachers. Bauhin's opinion on the function of the spleen was a greatly modified version of that of Ulmus, and corresponds more with Aristotle's original view.

Bauhin's description of the anatomical structure of the

spleen, its vascular connections and its nerves was drawn from Galen with such modifications as the various sixteenth century anatomists had made necessary. When Bauhin made theoretical comments about the function of some of the anatomical structures that he was describing, he drew upon Galen, although later on in the chapter he was to develop a theory which contradicted Galen. After he had described how the splenic branch of the vena porta joined the spleen Bauhin wrote, in Crooke's translation:-

"This Milt or splenicke branch carrieth to the spleene a thicke iuyce, the more earthie part of the blood, that there it might be wrought into his nourishment. But because some part of this iuyce is so grosse that it cannot be attenuated by the Spleene, and therefore as unprofitable must be segregated or separated, there are ordained two kindes of Vesselles to receyve it; one which belcheth it out upward into the left side of the bottome of the stomacke, sometimes up higher toward the left orifice, where with his sowrenesse he stirreth up the Appetite after the Chylus is gotten into the Veins of the Liver: so wee imitate nature, when we make sowre or sharpe sauces at supper, to provoke and recall our appetite which by our dinner was extinct and lost. Againe, this humour having a binding faculty, strengtheneth the stomacke, that his actions may be more firme." (57)

This is a completely orthodox Galenic account of how the non-digestible part of the spleen's food was expelled into the stomach and what its function was once it got there. Indeed, when Bauhin described the vas breve he stated explicitly that melancholic diseases existed and that the spleen was implicated:

"This Vessel also ^{is} of great use in Quartane Agues; for by it such patients are to good purpose by vomit purged, before and after the fit: for in these Agues, as also almost in all melancholy diseases, not onely the Milt [spleen] but the mouth of the stomacke is affected [quemadmodum omnibus fere melancholicis affectibus, non modo lien sed etiam os ventriculi afficitur]." (58)

This apparent agreement with Galen quickly evaporated when Bauhin discussed the function of the spleen. One is, in fact, presented with two conflicting views. This can be partly explained by the fact that Bauhin was writing a text-book which had to include Galen's teachings; however, it is not quite so simple. When Bauhin wrote specifically about the function of the spleen, he gave Galen's opinion only to reject it, but when he discussed subjects tangential to the function of the spleen where he did not differ from Galen - as in the case of the vas breve - he accepted Galen's accounts of the function of the spleen. The explanation for this probably lies in the inter-related nature of Galen's functional theories. If Bauhin was to be consistent, he should have altered the function of the vas breve so that it was consonant with his own view of the spleen's function; but this would have entailed too many changes in the system within which he was working. Therefore, Bauhin might disagree with Galen on a major issue, but he was not willing to take note of the wide extent of the ripples that his stone of dissent created.

In his account of the spleen's function, Bauhin related Galen's teaching on the spleen, which he stated was held by the majority ('Plerique ipsius usus statuunt . . .'),⁽⁵⁹⁾ and then gave his own opinion. To this, Crooke added a comment of his own, which shows his faith in Galen:-

"But against this common received opinion Bauhine in this place annexeth a long discourse, full of wit, but how consonant to the~~th~~eth, I will leave to others to iudge. It shall for the present [be] sufficient to make his conceite knowne unto you."⁽⁶⁰⁾

For Crooke, 'truth' approximated to Galen's teaching, for Bauhin it could be said that Aristotle sometimes took the place of Galen; but for both, 'truth' - at least in non-observable matters - does seem to need substantiation by its having been expressed at some time by some ancient authority.

Bauhin adduced seven reasons for doubting the opinion of Galen. Some of these were taken from Ulmus and other writers, whilst a few seem to have been original to Bauhin himself. Nearly all of them have the common characteristic of showing that Galen's view of the spleen's function produced inconsistency when related to his general theory of the body. Bauhin used the same method as had Ulmus and relied on the idea that there should be uniformity between comparable structures and functions. He wrote:-

"If the spleen , , , had oncly been appoynted to stable an excrement, it should not have been seated in the upper but in the lower part of the abdomen, as the other receptacles of excrements are: for so would it more commodiously have received so heavy and earth an excrement.

Againe, seeing of all the humours there is least quantitie of this melancholy, Nature would not have made the spleene bigger then the bladder of gall . . .

Moreover, if this had beene her only end, she would have framed in the spleene a large cavitie where this humour might have commodiously beene entertayned, as she framed a cavitie for the choller in the bladder of gall.

Fourthly, we must know and understand that no part ordayned for the separation of excrements, doth receive and naturally avoyd them by the same passages, as we may perceive by the kidneys and the bladder of gall. Fifthly, no part is nourished by the excrement which it attracteth but by laudible blood. Sixthly, as the passages of choller are dispersed through the substance of the Liver, among

the rootes of the gate and hollow veines, to draw away the excrementitious choller. So also should there have beene many propaginations and tendrils from the spleenick branch, dispersed through the substance of the Liver which we finde to be nothing so.

Finally, if from the Liver the foeculent blood bee purged away, as an excrement into the spleene, then it must of necessity follow that this excrementitious humour should regurgitate or returne into the trunk of the Gate-veine, because the splenick branch ariseth out of the same trunk far under the Liver, and above the trunk of the mesaraicks.

Wherefore we think, sayth Bauhine, that the spleene was ordained and instituted by Nature, for a further confection of some kinde of bloud. Which use, Aristotle first allotted unto it, and therefore in his third booke de partibus Animalium and the 7 chapter, hee calleth it a bastard Liver. The same also Galen giveth assent unto, in his [!] book de respirationis usu, as also Aphrodisaeus and Aretaeus: Vesalius and Fernelius, touch upon this use of the spleene also; but Platerus and Archangelus [Piccolomini] resolve upon it very confidently." (61)

In the first six reasons, Bauhin points out that if one held Galen's opinion, then the principle of similar structure - similar function would be denied; to that extent Bauhin shares with Ulmus the desire to make Galen devoid of contradiction and to produce a 'true' or 'correct' Galen. However, the intention of Bauhin was very different from that of Ulmus; for whereas Ulmus did not appeal to Aristotle but relied on his own ideas, Bauhin tried to produce a theory of the spleen's function which would be seen as essentially Aristotelean. He also tried to widen the extent of support for his view by mentioning the De Respirationis Usu [De Utilitate Respirationis] and attributing it to Galen although he must have known that it was considered spurious.

Although the intentions of Ulmus and of Bauhin were different the means to their respective ends were the same; and this indicates how, almost unconsciously, medical writers of the time accepted the general truth of Galen's view of the body and sought to validate any alteration in its details by appealing to the need for consistency in the general theory. The overall Galenic theory was accepted and believed in the very process of disproving some particular aspect of it. The touchstone of truth still remained Galen.

Ulmus had given to the spleen a pre-eminence, for according to him it produced arterial blood and this was superior to venous blood both in quality and ultimate purpose, in that the vital spirits in arterial blood were of a higher faculty than the natural spirits in venous blood. This is in contrast to the implication of Aristotle's teaching that the spleen was a bastard liver, for one would have expected the spleen to produce worse blood than did the liver, seeing that the spleen was inferior to the liver. Bauhin got much closer to this Aristotelean position:-

"The spleene therefore from an inbred faculty of his owne draweth unto himselfe the thicker and more earthie portion of the Chylus, somewhat altered in having received a certain disposition or rudiment of blood in the meseraicke veines, by the spleenick branch of the Gate-veine, out of the trunk of the meseraick veines before the Chylus get into the Liver; that so the Liver may the better draw the more laudable parts of the Chylus, for otherwise the small vessels of the Liver being obstructed by the crasse and crude bloud, not only sanguinification would have beene interrupted, but also the Jaundice, Dropsies, Agues, Scirrous hardnesses and many other mischiefes, woulde have overtaken us of necessity; all which we see do every day hapen when the spleene fayleth to do his duty; and either through weaknesse

or obstructions, ceaseth to attract that crasse and foeculent part of the Chylus. But a great evidence of this trueth is this; that the spleenicke branch doeth not proceede from the Liver, but ariseth as is sayde, and is seated below it." (62)

This explanation allowed the liver to make fine quality blood and the spleen to produce poorer blood whilst preserving the pathological function which had been served by melancholy. According to Galen melancholy was a by-product of the liver's haematopoiesis which was transmitted to the spleen, and if the spleen did not elaborate it properly then various diseases occurred. Bauhin implied that the thicker and earthier part of the chyle approximated to melancholy for if the spleen did not function then the melancholic diseases of jaundice and scirrhus would be engendered. This was taken up by later anatomists and made explicit. However, at this stage Bauhin did not completely exclude the Galenic form of melancholy; he stated that it did exist, but was not carried to the spleen, being instead, mixed with the blood in general:-

"yet wee doe not deny that melancholy iuyce is ingendred in the Liver, but wee say, that that onely is there ingendred which is a part of the masse of blood, not that which is received into the spleen, for his nourishment and the use of the stomacke." (63)

As melancholic diseases and the spleen had been inseparably connected by Galen, this divorce of the spleen and melancholy by Bauhin means that it is the grosser part of the chyle that should be seen as the old melancholy and which produces illness if not properly concocted by the spleen - and this was, in fact, how anatomists like Caspar Hofmann understood the change created by Bauhin. (64)

The provision for the retention of the pathological aspect of melancholy, albeit in an altered form, helped to make Bauhin more acceptable than Ulmus, who had largely ignored this problem, contenting himself with challenging the validity of the symptoms which previously were recognised as melancholic. Again when Bauhin came to repeat the central core of Ulmus's argument, he diluted much of its force and changed it from a radical assertion of major significance for the functioning of the body to a minor probability and so made it much more acceptable to the medical establishment. Bauhin wrote:-

"A part also happily of this humour thus altered is drawn into the next adjoining arteries, and so conveyed into the great Artery, to temperate the intense and sharp heat of the blood in the left ventricle of the heart, and to establish and settle the subtle and quick motions of the vitall spirits"
 [. . . in aortem mittitur, ad calidissimum sanguinem e sinistro cordis ventriculo haustum contemperandum, et spiritus in eo mobiles remorandos]."(65)

Although Bauhin admitted the possibility of blood going to the left ventricle of the heart from the spleen, its function was now merely to ameliorate the motion of the vital spirits rather than to act as the substantial vehicle of the vital spirits.

Bauhin also referred to the case observations which indicated that when the liver was diseased the spleen took over blood-making.⁽⁶⁶⁾ This was consonant with Aristotle's and his own opinion that the spleen was inferior to the liver, and is reflected in Bauhin's general conclusion where the role of the spleen in sanguinification is played down in contrast to Ulmus:-

"Wherefore we conclude that the Spleene is a great helpe to the Liver for the confecting of blood; partly because it maketh blood answerable to his owne Nature, partly because it averteth or draweth aside unto it selfe the thicker part of the aliment, not so fit to make pure blood, and by that meanes the Liver, unburdened of such a clogge, performeth his office of sanguinification with more facility . . . Notwithstanding . . . when a man is sound and hayle bloud is generated, yet it must needs be confessed, that there is more store of good and hot bloud fit for the nourishment of fleshy parts made in the Liver then in the Spleene, whose bloud is neyther so much, nor so hot, nor all out so good." (67)

The general effect of Bauhin's chapter on the spleen was certainly to alter the Galenic interpretation of the spleen's function but it was done in such a way that what might have appeared as extreme innovation in Ulmus became an acceptable alternative in Bauhin. Undoubtedly, the reason that Bauhin was able to do this was that, unlike Ulmus, he chose to make his position very close to that of Aristotle and to appear to be merely propounding an alternative opinion drawn out of the ancient authorities. This, in fact, was what it probably looked like to Bauhin himself; yet his chapter on the spleen contained more innovation than is to be found in any previous writer except Ulmus. Aristotle had not spelled out the consequences and details of his view; this is what Bauhin did in the name of Aristotle and because it was in that name, Bauhin was followed by such men as Harvey.⁽⁶⁸⁾ The magic reality of ancient opinion still held a fascination, though to men such as Laurentius any change, even if supported from the treasury of the ancients, carried the seeds of destruction for the old learning.

Yet, for a Galenist like Crooke, the name of Aristotle was not enough, in fact it probably had an aggravating effect. At the end of his translation of Bauhin's chapter on the spleen, Crooke wrote:-

"And thus I have acquainted you with Bauhin's conceit of the use of the Spleen, wherein me thinks he acquitteth himself, as Bellarmine doth in his disputations of the sufficiency of works in our Iustification, who after that in divers Books, and by manifold arguments he endevoureth to prove that works may iustify, yet in the end he concludeth, that it is more safe onely to trust to iustification by faith; so Bauhine for all his former arguments yet you see concludeth, that the more, better and warmer bloode is made in the Liver: as if hee should say, there is a little and cold blood made in the Spleen, not fit to nourish the fleshy parts, but onely his owne substance, which I thinke no man will deny unto him." (69)

The juxtaposition of Bellarmine's theological argument with a medical controversy shows a unity between fields of knowledge which today would be considered widely separated. By citing Bellarmine's conclusion that it is only safe to trust to justification by faith, Crooke pointed out that, similarly, Bauhin's opinion could not be proved by phenomena but ultimately rested upon a a priori belief and was thus merely possible and not certain. There can be little doubt that what constituted certain truth for Crooke would have been Galen's teaching. By stressing the point that Bauhin's new formulation of the spleen's function preserved the liver's primacy and that the spleen made only poor quality blood, Crooke was able to show that the respective positions of Galen and Bauhin were not so far apart. This is indicative of how Bauhin's views became acceptable to many anatomists; by

watering down the appearance of extreme radicalism given by the De Liene Libellus, Bauhin was able to present what was in essence a theory completely opposed to Galen as one sanctioned by the Philosopher and which was not so opposed to the Physician. Although Bauhin may not have set out deliberately to placate the Galenists, there can be little doubt that he was concerned to arrive at a theory which was close to Aristotle. The fact that it was Aristotle to whom he was reverting gave Bauhin not only a motive for altering Ulmus, but also allowed him to feel justified in the truth of the opinion that he was spelling out. In this sense one can see how the ancients could reach out and influence a writer, giving him the confidence to replace the opinion of one Greek for that of another.

Conclusion

Various other writers⁽⁷⁰⁾ developed and expanded Bauhin's ideas on the spleen; in fact Caspar Hofmann composed a full length book on the subject.⁽⁷¹⁾ However, no real change took place until Veslingius wrote the Syntagma Anatomicum (1641). Veslingius had the work of Aselli on the lacteals before him which meant that he could understand better the anatomy of the mesenteric region from which, according to Bauhin, the spleen would draw chyle. Veslingius wrote that the blood making faculty of the spleen was agreed to:- "according to the largest consensus of opinion." He went on to write that the ways however in which the material

is sent to the spleen were obscure just as if nature closed it in by darkness. Veslingius could not detect lacteal ducts leading to the spleen, nor, he wrote, was anything observed to be brought by the splenic vein or its branches to the spleen; even though he had made abundant vivisections and used ligatures.⁽⁷²⁾ In the end, Veslingius did not explicitly deny the new doctrine but his doubt is of the same nature as Vesalius's - he could not observe the anatomical conditions required by the functional theory. The wheel has come full circle.

What might appear as real change is illusory: the uncritical acceptance of Galen by writers like Fernel was certainly replaced, but the innovatory attitude of the later anatomists is deceptive to the extent that they merely substitute one authority for another. The crucial point is that this did not appear retrograde, for progressive anatomists, as well as old fashioned ones, deliberately sought the imprimatur of the ancients. In this sense the ideas which they used to explain the human body were not created by themselves, but were picked out of the writings of the ancients. The impression of dependence on the ancients is reinforced by the way that men like Bauhin used the principle of consistency in a theory to show that some detail was wrong, for, in doing this, the ancient frameworks of thought were implicitly accepted. In the next chapter I shall try to confirm this implied interpretation, that the view of knowledge held by the anatomists was basically static.

CHAPTER IVSENSE PERCEPTION, THE ANIMAL SPIRITS AND RETE MIRABILE

My study of the spleen and black bile has illustrated the static and derivative nature of the thinking of most sixteenth century anatomists when confronted with a physiological problem. Now, I intend to strengthen my conclusion by examining aspects of their writings on sensation.

At this point I should emphasize the obvious fact that in the case of sensation and the sense organs there is no simple duality of appearance and function, as there was in the spleen, which is expressed as part of the internal economy of the body. Sensation involves two other factors. One is the outside world which is perceived by the sense organs. The philosophical and scientific problem is how the world is related to the sense organs. Concomitant with the examination of this interaction there is the problem of deciding how the internal relationship between man's body and mind takes place. Therefore, although general philosophical or scientific conceptions of the nature of the world and man colour discussion of the physiology of an organ like the spleen, they are much more obvious and intrusive in the case of sensation.

The business of the anatomist since Galen has been to describe the anatomical structures and pathways by which the mediation between phenomena and mind occurs. The work of the anatomist will appear to be much more concerned with

specific detail than with philosophical ideas about the nature of sensation. Nevertheless, before the anatomist could begin to describe the anatomy of sensation, he must have decided upon his philosophical position, for otherwise his descriptions would have no explanatory content. Thus, an examination of the work of sixteenth century anatomists on sensation should reveal how fundamental ideas were used. Before writing about their work I shall discuss some aspects of Greek theories of sensation. In this way the uncritical and derivative nature of anatomical thought in the sixteenth century will be underlined. This will be especially apparent when I discuss an instance where the possibility of questioning Galen's ideas arose.

Furthermore, one must add that because the sixteenth century was so ^oderivative, it is the Greeks who are the more interesting and worthy of discussion. If one can show, as indeed I believe one can, that the theoretical work of renaissance anatomists is merely a repetition of the thoughts of the Greeks, then there is little point in examining all over again the same material.

Plato

For the Greeks the relationship between mind and the outside world was part of the question concerning the worlds of being and becoming. The problem posed by the ^{work of the} Eleatic philosophers of whether reality consisted in being and becoming was answered in different ways by Plato and Aristotle.

The solution that each gave permeated his entire philosophy, and theories of sensation were no exception to this. However, at first sight, the results are strange; for Plato, despite his denial of the illusory world of appearance, produced a very concrete and down to earth theory of sensation, whilst Aristotle was far more tentative in his formulation of a theory even though he accepted the world of becoming.

Plato, in the Timaeus, wrote of sensation as being the action of an agent upon the body. He based his theory upon an atomistic or corpuscular explanation. Sensation took place when external particles displaced the parts on the surface of the body, initiating a chain reaction, whereby

"the parts communicating with each other, until at last, reaching the principle of mind, they announce the quality of the agent." (1)

If the parts of the body yielded only after a struggle then there was a sensation of pain, so when the body returned to equilibrium there was corresponding pleasure. If, however, the change was imperceptible, there was neither pain nor pleasure. For instance, perfumes or burns produced sudden pleasure and pain but because the change back to normal was slow the equilibrating sensations of pain and pleasure were, in each case, imperceptible. Vision was the only sense which did not involve specific pain or pleasure, because sight:

"is a body naturally uniting with our body in the day time; for cutting and burnings and other affections which happen to the sight do not give pain, nor is there pleasure when the sight returns to its natural state." (2)

However, Plato's explanation of taste is typical of that given to other senses and it states that the source of perception lay in the heart:

"So when particles of earth enter the discriminatory passages which extend from tongue to heart, melt on contact with the moist and soft flesh and contract and dry the vessels, they produce, if comparatively rough, a sour taste, if less rough a dry taste." (3)

There is a mechanistic rather than a qualitative or Aristot^elean flavour about this explanation, consisting of a metaphorical analogy whereby the particular quality of perception induced by external objects depends upon the physical constitution of their basic elements. Thus a rough particle produces a sour taste, but:

"When the composition of the substances entering the mouth in liquid form is akin to the structure of the tongue, they smooth and mollify its roughened parts, and contract and relax, as the case may be, any unnatural relaxation or contraction, restoring its natural state; and any such remedy for states externally imposed is pleasant and agreeable and has been given the name 'sweet'." (4)

Plato's story in the Timaeus is full of concrete, almost mechanistic, detail. His description of sensation is written with heavy emphasis on the physical interaction, or fight, between the external world and man. The sense of physical battle is conveyed by Plato's explanation of how the mature adult is able to control the outside world instead of being overwhelmed by it. (5)

There is little anatomy in the Timaeus, but there is a great emphasis on the physical basis of sensation, for Plato's belief in being or in a non-phenomenological world

of forms did not mean that a 'likely story' about that world had to be ephemeral. On the contrary it is full of images derived from the world of becoming.

Aristotle

Plato had decided that the world of being was the real one. When Aristotle was faced with the same quandary posed by the Eleatic philosophers, he responded by developing a theory of the world which accepted the reality of phenomenological processes such as motion and growth. Aristotle, therefore, tried to produce a theory that gave a uniform rationale for the determinate events that seemed to occur in the world, such as the growth of plants or the motions of the heavens. Plato could use the images of the shadowy world of appearances with impunity, for, as he had rejected their reality, they could provide him with the simulacra for his likely story. Aristotle, if he was to progress beyond mere tautology, could not use the phenomena to explain themselves. Thus he developed abstract and qualitative concepts, such as potentiality, actuality and the four causes as well as unformed matter, elements and qualities which could not be found in a pure state in the corrupt world beneath the moon and were therefore not part of the phenomena.

This non-materialistic element that underlay Aristotle's explanation of the world and its processes was the basis of his theory of sensation. Aristotle centered his explanation of sensation around his concept of 'soul', and he developed

this most fully in De Anima. He defined soul in general as:

"substance in the sense of being the form of a natural body, which potentially has life. And substance in this sense is actuality. The soul, then, is the actuality of the kind of body we have described." (6)

Soul was the expression of life in matter and it endowed matter with both form and its capacity for action. However, the actuality of soul could only be seen in the physical existence of matter. At this point I want to make it very clear that Aristotle did not intend his 'soul' to have the spiritual or metaphysical sense which is contained in the post-Cartesian use of the word. Aristotle, in fact, had a diametrically opposite idea of the meaning of 'soul' for he tried to unite the concepts of life and matter through 'soul' rather than separating them. Thus, he wrote:

". . . one need no more ask whether body and soul are one than whether the wax and the impression it receives are one, or in general whether the matter of each thing is the same as that of which it is the matter; for admitting that the terms unity and being are used in many senses, the paramount sense is that of actuality.

We have, then, given a general definition of what the soul is: it is substance in the sense of formula; i.e. the essence of such and such a body." (7)

Aristotle's meaning becomes clearer and more concrete when he describes the difference between a living and dead eye:

"If the eye were a living creature, its soul would be its vision; for this is the substance in the sense of formula of the eye. But the eye is the matter of vision, and if vision fails there is no eye, except in an equivocal sense, as for instance a stone or painted eye." (8)

We, with our distinction between minds and bodies, might accuse Aristotle of evading the issue of how the eye functions

and we might well say that he was using soul not only as a description of the state of a substance but also as the causal explanation of that state. This is to misunderstand Aristotle. For the early Greeks the phenomena of the living world contained far greater reality than the elements of dead matter. By using the term 'ψυχή' as a description of animate matter Aristotle introduced a neutral concept which lessened the hylozoism induced by the apparent reality and force of living processes. An analogy can be found in the neutrality of numbers which gave to seventeenth century science an independent and non-subjective mode of description. Aristotle's 'soul' does not, of course, have the flexibility or the radical power of quantification; nevertheless, it is of the same nature for it was an attempt to describe life by means of a term which was not derived from the images of life.

This may appear a paradoxical and labyrinthine conceit, yet it is only so because the term 'soul' for the twentieth century has the connotations of spiritualism and animism, and seems generally heretical to the dogma of mechanical reason. It is important, however to grasp the implications of Aristotle's conception of soul; for it enabled anatomists from Galen to the time of Descartes to give a materialistic description of the anatomy of sensation untroubled by the problem of a duality between the mind and body.

If we return to Aristotle's theory of sensation it is

clear that the eye, in Aristotle's example, when considered as part of the body and not as a living creature per se, was part of the soul. The formula or soul of a living being would include in itself the faculty of vision. Thus, the other powers of sensation that a man possesses would also be attributes of the common soul. Aristotle's view of sensation was based upon the obvious and apparent powers of perception inherent in the body. Plato, in his story, could build a model of man in which sensation occurred by the mechanical interactions of corpuscles; whether this mirrored reality or was a likely story did not matter. Like Descartes's Man Machine, the correlation with reality is not necessary, nor perhaps is it important for such a priori stories. For Aristotle the correspondence of his explanation of the powers of the body with what actually happens (i.e. at a naive phenomenological level) was both necessary and important. Aristotle had accepted the world of becoming, and the soul as the expression of the functioning body was part of that world.

However, for reasons that I have previously discussed, Aristotle relied upon a qualitative rather than a particulate or materialistic explanation of the world and this posed problems. His theory of sensation got into difficulties when it had to explain the evident fact that the body was affected by the outside world in different ways. He was willing to consider the nature of the objects of sensation⁽⁹⁾ but he could not accept Plato's idea that the particles which made up the objects of the outside world

directly produced sensation by reacting with the particles and pores of the body.

Aristotle used the concept of a medium to get over the difficulty. By means of a medium the quality of a sense object was conveyed to the sense organs and a direct interaction was avoided. In the case of light the medium was the 'transparent,' for sound it was air and for smell it was the moistened medium of air. In these three instances the change or appearance of sensory impressions takes place in the medium and not in the living body. Once the medium is altered it activates the appropriate sense organ from its state of potentiality⁽¹⁰⁾ and it can convey the sense impression to the understanding. Taste and touch which appear to have no medium do, in fact each possess one, the tongue and skin respectively. The crux of the matter is that in this way the body perceives but is not physically acted upon by the sense object. Aristotle wrote:

"We must understand as true generally of every sense (1) that sense is that which is receptive of the form of sensible objects without the matter, just as the wax receives the impression of the signet-ring without the iron or the gold, and receives the impression of the gold or bronze, but not as gold or bronze; so in every case sense is affected by that which has colour or flavour or sound, but by it, not qua having a particular identity, but qua having a certain quality and in virtue of its formula." (11)

The influence of Aristotle's teaching for the sixteenth century anatomists is two-fold. At one level they repeat almost verbatim some detail such as the analogy between flavours and colours:

"as black is a privation of white in the transparent so the salt or bitter is a privation of the sweet in nutrient moisture." (12)

At the other, more profound level the influence of Aristotle is that by his concept of the soul he elaborated a monistic view of the mind and the body. The anatomists concentrated on supplying detailed descriptions of nerve pathways and of the sense organs and the brain. However, Aristotle's soul was the expression of the totality of the body and although it had no spatial parts, the nerves, brain and sense organs were all subsumed under the idea of soul. Thus, as Aristotle had given to the soul a physical, and not a spiritual basis, the difficulties which might have been posed by a mind-body distinction were not to appear until the time of Descartes.

Finally one should note, almost as an afterthought, that the anatomical knowledge that Aristotle displayed of sensory perception was both rudimentary and erroneous. He had no real conception of the nerves and on the crucial issue of the origin of sensation he asserted the primacy of the heart. Despite this, Aristotle's influence was immense. One has only to imagine the problems that would have been posed for the early anatomists if a Cartesian duality between the mind and body had existed.

Galen

There is an obvious and fundamental difference between Aristotle and Galen. The brain and not the heart was

recognised by Galen as the source of nerves' and of sensation. Furthermore, Galen described the pathways of the nerves and demonstrated by experiments the difference between motor and sensory nerves.

Although Galen disliked atomism⁽¹³⁾ his theory of sense objects was largely drawn from Platonic corpuscularism. He did not use the word 'atom' but the words 'ἄωμα' and 'μέρος' meaning body or part. In the treatise De Simplicium Medicamentorum ac Facultatis Galen wrote that acid flavours were quickly carried through the sensory parts whilst sour flavours were slower. This was because sour bodies were thick or fat ('παχυμερῶς') and remained on the surface of the body whilst acid substances were thin ('λεπτομερῶς') and could travel to the depths of the body.⁽¹⁴⁾ Again, in De Symptomaticum Causis Galen stated that grosser bodies produced a greater sensory effect and he also wrote that smell, which was similar to taste, differed from taste because it could distinguish smaller bodies ('τῶ λεπτομερεστέρω τῆς οὐσίας') as the vaporous humour by which we smell is attenuated.⁽¹⁵⁾ This almost Platonic side to his views on sensation did not greatly influence Galen's anatomical and physiological account of sense perception.

Galen's theory of sensation is based upon the animal spirits. These were manufactured out of arterial blood, which contained the vital spirits, and air. The arterial blood flowed in the carotid arteries from the heart to the rete mirabile. In the convolutions of the rete mirabile the

vital spirits were elaborated and partly altered into animal spirits. The final concoction occurred when the vital animal blood flowed from the two arteries which arose from the rete mirabile (aa. carotides cerebrales) into the encephalon.⁽¹⁶⁾ The change into animal spirits was completed as Margaret May writes: "in the ventricles of the brain by the brain's parenchyma and with the aid of external air brought in from the nasal passages by way of the channels extended into the olfactory bulbs in the animals Galen was dissecting."⁽¹⁷⁾ Unfortunately for Galen's theory the rete mirabile was not present in man. How the sixteenth century anatomists reacted when this was discovered will be discussed later.

The animal spirits were conveyed within the nerves which were believed by Galen to be hollow. It does not lie within the scope of this thesis to describe the striking experiments whereby Galen differentiated between motor and sensory nerves and established the brain as the origin of sensation. However some mention of Galen's writings on the nervous system may help to give a more complete picture of his ideas on sensation.

In the Use of Parts Galen gave a qualitative and teleological explanation for the way in which the motor and sensory nerves were differentiated:

"Each of the sense instruments needs a soft nerve. It needs a nerve because nerves are the instruments of sensation, and a soft one because, if there is to be sensation, a sense instrument must somehow be acted upon and affected by the exterior objects encountered, and a soft substance is better suited to receive impressions, whereas a hard one is more

suitable for acting. This is the reason why the sense instruments need soft nerves and all the other parts that are moved by appetite need hard ones." (18)

It is obvious however, that it was from experience rather than from an a priori conception regarding softness and hardness that Galen was able to make the distinction between the sensory and motor nerves. The passage immediately following the one above indicates that this was the case:

"Those sense instruments, however, that are moved by the will, like the eyes and tongue, have both kinds, unlike the ears and nose, which have only soft nerves. As a result, if either of the nerves [of the eyes or tongue] is injured, the part is disabled only in respect to the usefulness depending on that nerve." (19)

Galen stated that as there were two types of nerve the brain had to have two natures. The cerebrum was soft and hence the origin of the soft sensory nerves, whilst the cerebellum was hard and hence the origin of the hard motor nerves. (20) The further a nerve travelled, the harder it became because of the greater likelihood of its being damaged. However, in the case of the vagii nerves which had to remain soft because the stomach needed to have the sensation of hunger, nature protected them by surrounding them with strong membranes. (21)

These elements of Galen's teachings were to be repeated by later anatomists without much critical discussion. What was debated was the enumeration and delineation of the nerves. This is what one would expect, for these are purely observational details and not matters of theory.

On the whole, Galen appears to be far more concerned with the particular and less with the general than was Aristotle. Nevertheless, despite Galen's espousal of some of Plato's ideas, he was greatly indebted to Aristotle. Aristotle provided him with the concept of the soul as the monistic expression of living substance. The animal spirits were a physical instrument of the soul and there was no need of something like the pineal gland to act as an intermediary between body and mind; for the soul being the formula of active substance admitted of no schism between body and mind. Thus, when Galen gave a physical description of the nerves and then wrote of the animal spirits in the brain as receiving the sense impressions there was no uncomfortable dualistic fence to jump.

It is true that Galen's conception of the soul was vaguer than Aristotle's and he often equated it with Nature. (22) Nevertheless, as Galen makes it clear in the Natural Faculties, (23) Nature represents the best possible workmanship that can go into making the body and to understand the working of Nature is to understand the construction of the body. So whether Galen uses 'soul' or 'Nature', both express the attributes of the body and Galen's approach is as monistic as Aristotle's. Untroubled, therefore, by any nagging doubts about the relationship between mind and body Galen was able to develop a physiological theory of sensation which was rooted in the materialistic topology of the body.

The Renaissance Anatomists

If one hopes to find great changes in ideas about sensation in the work of the sixteenth century anatomists, he will be disappointed. There was, with the exception of Vesalius and Argenterius, a general lack of critical or original thinking on the subject of sensation. I shall describe, moreover, how, when the anatomists were presented with the possibility of questioning Galen's theory, they failed to take advantage of this opportunity.

In the work of the renaissance anatomists the general philosophical discussions of the nature of sensation which had begun to be muted in Galen became practically nonexistent. Of course there were descriptions of the nature of sensation but these are merely derivative copies and the dead letters of Galen's teachings supplemented with leavings of Aristotle. The quality of living, sometimes acrimonious, debate is to be found in the differences of opinion concerning the paths, insertions and numbering of the nerves. (24) Yet it remains a fact that all the new observations which were made to check Galen's observations were still expressed in the terms supplied by Galen's basic explanation of sensation. Thus the reader should not be surprised that the last part of this chapter appears sterile. Much of the theoretical work of the anatomists is devoid of interest. (25) This mirrors my chapters on the spleen, where Galen's establishment of the theory explaining the function of the spleen

and black bile is far more interesting and worthy of detailed analysis than the subsequent reworkings of the majority of sixteenth century anatomists.

The most cogent and lucid appraisal of theories of sensation is contained in the eighth book of Vesalius's Fabrica. The reader should refer to O'Malley's biography of Vesalius for a good and succinct account of it. (26)

Vesalius poured scorn on the medieval localisation of the faculties of the soul in the specific parts of the brain, denied the existence of the rete mirabile in man and expressed doubt about the nature of the animal spirits. His comments on these three subjects indicate his belief, which he had expressed in the case of the spleen, of the necessity for observation as a test of functional theories.

Vesalius reacted very strongly against the medieval idea that the faculties of the soul could be given a particular physical location in the brain. For example, Mondino had written that:

"Ere thou attain the depth of the lacuna cerebri note that this ventricle is cleft into right and left, as I have stated . . . Thou wilt see at once the size of each ventricle in front that is in the anterior angle, wherein is fantasy, that is the power which doth retain the species received by the special senses. In the posterior angle is placed imagination, the power which doth apprehend those species retained by fantasy." (27)

As in the case of the spleen Vesalius could not see the anatomical structures which could produce the specified functions and he wrote:

"I can in some degree follow the brain's functions in dissections of living animals, with sufficient

probability and truth, but I am unable to understand how the brain can perform its office of imagining, meditating, thinking and remembering, or following various doctrines, however, you may wish to divide or enumerate the powers of the Reigning Soul.

If by accurate and painstaking examination of the parts of the brain, and from an observation of the other parts of the body, the use of which is obvious even to one little practised in dissection, some analogy were traceable, or if I could reach any probable conclusion I would set it out, if I could do so without injury to our Most Holy Religion [fidei]." (28)

Vesalius did not mean that it might be impious of him to discuss the soul. What he is saying is that anatomy can offer no justification for the elaborate system of relating the faculties of the soul to specific locations in the brain. The impiety had already been committed by those who had framed the system without regard of the real structure of the brain. Vesalius wrote:

"Who, immortal God, will not be amazed 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 Prometheans, and with the greatest impiety towards the Creator, fabricate some sort of brain from their dreams and refuse to observe that which the Creator with incredible providence shaped for the uses of the body. They parade their monstrosity, shamelessly deluding those tender minds that they instruct." (29)

The extreme form of the medieval localisation of the faculties can be seen as a confirmation of the monistic nature of Aristotle's concept of the soul; for writers like Mondino had given to the soul the physical representation which was implicit in Aristotle's teaching. When Vesalius produced a further reason against the 'theologians' he attacked this monistic attitude, and, in a sense, prefigured Descartes:

"Now I do not deny that the ventricles bring the animal spirit into being, but I hold that this explains nothing about the faculties of the Reigning Soul. Yet those men who glory in the name of theologians, . . . so assign them. All our contemporaries, so far as I can understand them, deny to apes, dogs, horses, sheep, cattle and animals the main powers of the Reigning Soul . . . and attribute to man alone the faculty of reasoning; and ascribe this faculty in equal degree to all men. And yet we clearly see in dissecting that men do not excel those animals by [possessing] any special cavity [in the brain]. Not only is the number [of ventricles] the same, but also all the other things [in the brain] are similar, except only in size and in the complete consonance [of the parts] for virtue (temperamenti ad justitiam integritatem)." (30)

Earlier on in the eighth book of the Fabrica Vesalius had made an almost identical statement, ⁽³¹⁾ and it is therefore no isolated accident that he foreshadowed Descartes in this way. Indeed, if my general interpretation of Vesalius is correct, one would expect this; for in the eyes of Vesalius a theory could only be held to be valid if there were anatomical structures to confirm it. The processes of the mind did not appear to be caused by observable physical structures to Vesalius or by hypothetical corpuscular interactions in the case of Descartes.

As O'Malley writes, Vesalius's doubt extended to the animal spirits. Vesalius could not see passages in the nerves which would convey the spirits, and he wrote:

"I hesitate to dispute whether that very tenuous spirit is directed through passages of the nerves, like the vital spirit through the arteries, whether along the sides of the body of the nerve like light along a column, or whether the nerve force is extended to the parts merely by the continuity of the nerves." (32)

This doubt was probably increased by the fact that Vesalius could not find in man the rete mirabile in which, as Galen had taught, the change of vital spirit to animal spirit was initiated. I shall return to this later.

No one, apart from Argenterius, whom I discuss in chapter seven, went beyond Vesalius. The lack of critical or original thinking can be illustrated by comparing the writing of Laurentius, Bauhin and Harvey. Laurentius wrote in the Historia Anatomica:

"Furthermore this spirit which is the immediate Organ of Sense and Motion and of all the principall faculties, is indeede of one kinde notwithstanding it is esteemed manifold according to the variety of the objects and instruments where about it is imployed: which thing Aristotle elegantly hath taught us in the last chapter of his 5. booke de generatione Animalium.

The spirit sayth he in Naturall things is like the hammer in the Art of the Smith, that is to say, but one instrument, yet profitable for the performance of many offices. Actuarius compareth it to the beames of the Sunne, which though they bee all of one kinde yet they become unlike when they light upon different colours." (33)

Similarly, Bauhin wrote in the Theatrum Anatomicum:

"This Animall spirit although it performe many services is one and the same; . . . but the Instruments into which out of the braine it is powred into the Nerves are manifolde. Wherefore if they runne into the eyes which are the Organs of the sight they make Vision; if into the eares Hearing etc. This Aristotle (in his second book de generatione Animalium and the last texte) elegantly declareth by example of a Smiths hammer, for as the hammer is but one instrument yet it doth many services according to the variety of the subiect upon which it worketh; so is the spirit in the whole of Nature's administrations; and as the beames of the Sunne are one and the same yet appeare divers if they light upon divers coulers, so it is with the animall spirits." (34)

If one compares the original Latin the similarities are even more striking.⁽³⁵⁾ There is no difference between Laurentius, the conservative Galenist, and Bauhin the neoteric Aristotelean. Bauhin did not even repeat Vesalius's doubt about the transmission of the animal spirits, for he stated that when the brain:

" . . . contracteth ^t ~~is~~ selfe it driveth out the Animall spirits laboured in his substance through the nerves, as through pipes and canals into the organs of sense and motion" ("dein vero se contrahit, animale spiritum in cerebri substantia elaboratum per nervos tanquam canales in sensuum et motuum organa propellit") (36)

Laurentius gave a detailed account of the manufacture of animal spirits⁽³⁷⁾ but he did not give any definite description of what they actually were. In the 'Controversies' of the Historia Anatomica we can see the general vagueness and imprecision with which he described the animal spirits. In his reply to Argenterius who had asserted that there were not three types of spirit but only one, Laurentius wrote:

"Eightly hee (Argenterius) objecteth that the influence of an Animal spirite is not necessarie, a quality onely or beaming light might be sufficient, for nothing that is corporeal is moved in an instant. But we know that the Muscles obey the Braine according as our will commandeth them, for we are able in the twinckling of an eye to move our utmost ioynts. We answer that the spirit which is the Organ of the soule dooth instantly accomplish the commandement thereof and is ever adrest in the Nerves, and as it is spent repayred by new influence and succession; whence it is that before the exhaustion or expense of the olde a new is ministred to supply the roome." (38)

Such meaningless descriptions of the animal spirits might have awakened some doubts in Harvey, whose Anatomical Lectures are based upon Bauhin's Theatrum Anatomicum.

However, his remarks on the animal spirits are prefaced by the letters 'W.H.' which means that he had given some thought to the matter and not merely copied Bauhin. In fact, Harvey seems to have decided between the alternatives that Vesalius had hesitated to dispute:

"W.H. . . . Do both the faculty for movement, and the actuality of movement, that is to say, the spirits, pass right through the nerves, or, as Galen has it is the faculty with or without the actuality? I think that the spirits do not march forward in the nerves, but that they shed radiance like the sun and cause actions, and so the sensory and motor spirits are like the light in the air, or perhaps like the ebbing and flowing of the sea. The spirits shed radiance on everything that is under their influence . . ." (39)

Harvey did not go beyond Laurentius or Bauhin and it is clear from the satisfaction of the three men with the use of the image of the sun's rays that none of them approached Vesalius in critical insight.

O'Malley has written that:

"For lack of any alternative theory, animal spirit retained its presumed importance as late as the second half of the eighteenth century and investigators up to that time, unhappy as they might be, were compelled to attempt explanations of brain functions more or less within the framework of this ancient theory." (40)

Certainly, Vesalius was unhappy but most other anatomists up to and including Harvey were happy to work within the vague bounds of the theory of animal spirits. Perhaps Aristotelean medical men like Bauhin and Harvey shied away from the implications of Vesalius's doubt, for one solution would have been to have erected the Cartesian mind-body distinction which was completely opposed to Aristotle's teaching.

Paradoxically, Argenterius tried to replace the three Galenic spirits with one, which was analogous to the monistic soul of Aristotle.⁽⁴¹⁾ However, no one supported Argenterius and we are left with the situation that for the majority of anatomists there was no critical impulse to question the idea of animal spirits.

The Rete Mirabile

Vesalius wrote in chapter twelve of the eighth book of the Fabrica:

"How many things have been accepted on the word of Galen . . . and often contrary to reason. Among them is that blessed and wonderful reticular plexus which he constantly affirms in his books. There is nothing of which physicians speak more often, and even though they have never seen it . . . yet they speak of it on Galen's authority. Indeed, I myself am wholly astonished at my (former) stupidity and too great trust in the writings of Galen and of other anatomists. In my devotion to Galen I never undertook the public dissection of a human head without having available that of a lamb or ox to supply whatever I could not find in the human, and to insure that the spectators not charge me with failure to find that plexus so very familiar to all of them by name. The internal carotid arteries wholly fail to produce such a reticular plexus as that described by Galen."⁽⁴²⁾

The reaction of sixteenth century anatomists following the non-observance of the rete mirabile in man is a story of prevarications, replacements, adjustments and a general 'fudging' to explain how the animal spirits were in fact manufactured. Apart from Argenterius, no one used the non-existence of the rete mirabile to deny the animal spirits; the modern hypothetico-deductive model did not work in such

cases in sixteenth century anatomy and physiology.

As the rete mirabile could not be observed the anatomists had to decide how the animal spirits were generated. Galen had, admittedly, given them some leeway; for the animal spirits were given only their first alteration in the rete mirabile and were finally concocted by the substance of the brain when they entered the ventricles. Thus the stay of the spirits in the rete mirabile was but a stage in their production, and perhaps not absolutely essential.

Vesalius made a straightforward replacement of the rete mirabile by the cerebral arteries:

"... the Maker of the Universe has used far greater ingenuity than Galen imagined. For He has contrived for the great soporal artery a tortuous channel with a long passage (= carotid canal) in the bone, and he has willed for this passage the very thing for which Galen imagined that the plexus had been built to wit, that the vital spirit be thoroughly concocted in the many turnings and twistings of the artery, and its matter be so prepared for producing animal spirit." (43)

The final production of the animal spirit was:

"From the air which has entered the brain, and from that vital spirit which, by its devious course, becomes progressively more assimilated in the ventricles to the action of the brain, the animal spirit is elaborated by the cerebral power ('virtus'). We believe that this power depends on the opportune balancing of the elements of the brain substance." (44)

Vesalius's replacement of the rete mirabile by a similarly convoluted and tortuous arterial structure set the pattern for some of the anatomists who followed him. Realdo Colombo in the De Re Anatomica replaced the rete mirabile with the choroid plexus, which did exist in man:

"Through these frontal ventricles of the brain the choriform plexuses [choroid plexus] are lead, which we have called reticular. Their use is, in fact, the generation of animal spirits. And what I now relate, since it is my invention, I implore attend to carefully . . ." (45)

Colombo went on to describe how the air drawn in from the nose passed through the ethmoid bone and was mixed with the vital spirits in the reticular (choroid) plexus and so the animal spirits were produced. He concluded with characteristic pride:

"Which matter was observed by no one before me." (46)

When Archangelus Piccolomini came to discuss the problem in the Anatomicae Praelectiones he tried, as in the case of the spleen, to have the best of both worlds. He stated that in the rete mirabile the animal spirits were inchoate and received their full character in the choroid plexus. Similarly, animal spirits were only conserved in the ventricles, their perfection occurring in the substance of the brain. (47) Piccolomini appealed to other step by step processes that were said to take place in the body to justify his new scheme citing the way in which venous and arterial blood was made. (48) Nevertheless, whatever Piccolomini's reasoning, the fact remains that he accepted both the rete mirabile and the choroid plexus. There is not an iota of doubt or critical insight to be found in what Piccolomini said on the subject, since all he was interested in was to reconcile different points of view.

The writings of Andreas Laurentius on the subject are similar to those of Piccolomini. In chapter ten of the

tenth book of the Historia Anatomica he wrote that for the preparation of animal spirits plexuses had been constructed which had a labyrinthine structure of little veins and arteries.⁽⁴⁹⁾ A little later in the same chapter, however, Laurentius wrote that he preferred to name the plexus which Galen had called rete mirabile, the choroid plexus, as the 'neoterics' had done.⁽⁵⁰⁾ Rather than assert that Galen was wrong, Laurentius tried to hide Galen's fallibility and stated that what was involved here was a mere change in terminology.

The prevarications did not stop there, however. In his reply to the question 'What is the Nature of the animall spirit, what is the manner of his generation and the place thereof,' Laurentius asserted:

". . . there is stored up a supply against time of need in those two complications or textures called Plexus Choroides and Rete mirabile . . .

The preparation of this spirit is made in those Labyrinths of the small arteries, their coction or elaboration (as some think) in the ventricles . . .

They therefore are in error who do conceive that this spirit attaineth his proper forme and specificall difference in those textures. For all the complications of vessels as well in the braine as in the testicles and other parts are ordained onely for preparation, but the forme and difference of a thing is supplied by the substance of the part, both to the Aliment and to the spirit.

Wherefore we conclude, that in those complications [choroid plexus and rete mirabile] the spirits are prepared, that in the ventricles they are boyled and labored, but receive their uttermost perfection in the substance of the Braine." (51)

Thus Laurentius accepted, like Piccolomini, the existence

in man of both the rete mirabile and choroid plexus. Apart from their difference over the action of the ventricles (Piccolomini stated that the animal spirits were only stored there), the views of the two men are identical and both shared the same confidence in the truth of their conclusions.

From his writing on the spleen we might expect that Caspar Bauhin would exert his critical abilities on the problem. Unfortunately it is impossible to know what his attitude would have been for he stated categorically that he had seen the rete mirabile in man:

"Vesalius affirmeth that this wonderfull Net is onely found in the heads of beasts, but we . . . have beene able to make demonstration of it in all the mens heads we have hitherto cut up, although we confesse that in Calves and Oxen it is much greater and more conspicuous." ("nam in omnium hominum capitibus hactenus demonstrauius; non tamen negamus in vitulorum et boum capitibus multo et maius et manifestius conspici.") (52)

Bauhin did not arrive at any conclusion of his own but merely contented himself with repeating the opinions of other people. As he had observed the rete mirabile to his own satisfaction there was no problem for him, and so, like the good textbook writer that he was, he gave the views of other authorities.

Harvey's opinions on the rete mirabile were taken from Bauhin, as the following shows:

"The rete mirabile. Concerning this great laboratory of the animal spirits see Galen. It is formed from a network of the branches of the carotid arteries and completely surrounds the hypophysis on all sides. It extends from the sides of the sphenoid bone . . . Bauhin contradicts Vesalius and maintains that it does exist in the human head . . ." (53)

Perhaps Harvey's disinclination to give a personal opinion

is a sign of caution; but certainly there is little doubt or questioning to be found in his writing.

Conclusion

The choices open to the anatomists in developing a theory of sensation were even fewer than those that existed in the case of the spleen. The Aristotelean alternative did not really exist because the anatomical impossibility of the heart's being the origin of sensation had been amply demonstrated by Galen. Thus, there was no other established theory to which the anatomists could turn; they had either to create a new theory or to cover up the ^uunfortunate discovery that the rete mirabile did not exist in man. To have denied the physical reality of the animal spirits might have opened a schism between the mind and body and this perhaps prevented anatomists from adopting the doubts that Vesalius expressed in the Fabrica, concerning the animal spirits.

The present example of the animal spirits and rete mirabile has, I feel, amply supported my contention that when anatomists were faced with an observational anomaly in a theory, they did not attempt to create a completely original theory in its place. In the case of the spleen the anatomists fell back on Aristotle, whereas in this instance they merely glossed over the difficulties. In neither situation is there a sign of real originality of thought.

PART II

Introduction

As I have already shown in the first part of my thesis, the core of physiological theory did not change during the sixteenth century, notwithstanding frequent appeals to observation of the human body as a means of testing traditional doctrines. So far I have been concerned only with a small part of the medical profession, the anatomists, and I have not considered the contemporary concern with the problem of how new observational data might or might not be related to traditional theory. In the second part of my thesis I am extending my examination beyond the ranks of the anatomists to take into account the opinions of those interested in the philosophical standing of medical knowledge. What will become evident as the enquiry proceeds is the belief, held almost universally, that observational data could not, by its very nature, alter the fundamental principles upon which medicine had rested since antiquity.

CHAPTER V

SANCTORIUS

Introduction

Sanctorius Sanctorius was born in Capodistria in 1561. He was educated in philosophy and medicine at the University of Padua for seven years between 1575 and 1582, when he received his degree of doctor of medicine.

Between 1587 and 1611 Sanctorius practised medicine in Poland. Whilst in Poland, he wrote the Methodi Vitandorum Errorum Omnium qui in Arte Medica Contingunt (1603). However, during this time, he interspersed his stay in Poland with visits to Padua where he became a friend of Galileo's, and in 1611, was appointed professor of the theory of medicine at Padua. From 1616 until 1624, he was president of a new college in Padua, the Collegio Veneto. In 1624, after some internal disputes, Sanctorius resigned and went to Venice to practise medicine, where he died in 1636.

Sanctorius lectured on Galen's Ars Parva, on Avicenna's Canon and on the Aphorisms of Hippocrates. He published these lectures as the Commentaria in Artem Medicinalem Galeni (1612), the Commentaria in Primam Fen Primi Libri Canonis Avicennae (1625) and the Commentaria in Primam Sectionem Aphorismorum Hypocratis (1629), respectively. The most famous work of Sanctorius, however, was his Ars de Statica Medicina published in Venice in 1614. This book went through many Latin editions and translations and was undoubtedly the

work by which Sanctorius was remembered by the generation that followed him. I intend to examine the attitude of Sanctorius towards his work; and, so that Sanctorius's outlook as a whole can be considered, the pre-eminence^e of the Statica will have to be lessened.

A thread underlying much of the earlier chapters has been the theory of qualities as developed by Aristotle and Galen. It has been my contention that, in the cases of the spleen and the rete mirabile, this theory was not challenged in orthodox, non-alchemical, medical science. Thus, it is interesting to examine the work of a man who might appear to doubt the concept of the qualitative theory. Walter Pagel, amongst modern historians, mentions both Sanctorius and Van Helmont as developing a quantitative approach. As Van Helmont was outside the medical establishment whilst he was alive, I have^e decided to concentrate on Sanctorius.

If we are to believe Arturo Castiglioni, Sanctorius must be seriously considered as pointing the way towards a new approach in medicine. Castiglioni wrote of Sanctorius that:-

"with his quantitative experiments [he] opened a new line of medicine, the importance of which he appears to have realised. Before Sanctorius, only qualitative changes had been the object of medical study. With his innovations and particularly his studies of the 'insensible perspiration' as he called it, the first investigation of metabolism in pathology and physiology brought to research a quantitative

basis controlled by instruments of precision."⁽¹⁾

And also:-

"But more important even than the practical results is the value of this book [the Statica] in making proved experiments the basis of all his observations and conclusions, thus constituting one of the most courageous affirmations of experimental medicine."⁽²⁾

I hope to show that Castiglioni was mistaken, and that although Sanctorius did use quantitative techniques these were for the purpose of making the existing theory of medicine more exact; he did not use his new techniques as heuristic tools which would help him to create new theories. It was the phenomena of medicine and not medical theory that Sanctorius considered to be in doubt and which could be more accurately discerned by his instruments and experiments.

Sanctorius was explicit in his attitude towards his work. In his role as professor of the theory of medicine at Padua he discussed the limitations of experience and experiments and wrote on the nature of scientific knowledge in his Commentary on Avicenna's Canon and in the Methodi Vitandorum Errorum. He was one of the few writers on medical theory who also did experimental work in medicine, so his more philosophical writings assume a greater interest.

Sanctorius is a pivotal character, not only because we can clearly see through his writings the ideas on theory which are implicit in the work of the anatomists, but also because he contributes to the discussion on medical method

and theory. In the next chapters I shall discuss how a consistent tradition on medical method developed following the work of Leoniceno of Ferrara. In the present chapter, however, the writings of Sanctorius on method will be considered in isolation. This will enable a complete picture of Sanctorius's views on theory and experience to be given without interruption.

Sanctorius and the Idea of Exactness

In this section I intend to show that Sanctorius developed techniques of quantification, not because he wanted to disprove the doctrine of qualities, but because he wished to make knowledge of the phenomena more precise. Thus the appearances could be placed with more certainty and exactness within the qualitative theory that would explain them. In order to achieve this aim Sanctorius used various instruments of measurement. In the Commentary on the first part of the first book of the Canon of Avicenna Sanctorius wrote at some length about the thermometer, pulsilogium and hydrometer, the use of which he advocated enthusiastically. He not only gave a description of each instrument, but he also discussed the reasons for their use.

Early in the Commentary, in Question 6, Sanctorius asked: "In what way is the medical art conjectural?" He replied that "The medical art is conjectural in the calculation of the quantity of diseases, of the power of remedies (and)

in the understanding of their constitution."⁽³⁾ Sanctorius quoted Galen to the effect that to prescribe a remedy properly not only must one know the type of illness but also its quantity (degree) and that "it is only possible to guess at the measure of a quantity which has departed from its natural state,"⁽⁴⁾ whereas a definite measure was necessary to medicine.

This, then, was the problem. Sanctorius wrote that he had considered for a long time how the quantity of diseases could be known and that he had thought of four instruments.⁽⁵⁾ Of his first instrument he stated:-

"The first is our pulsilogium, by which through mathematical certainty and not conjecture we can mark out to the last degree the pulse flow, its quickness and slowness." ⁽⁶⁾

Sanctorius gave a description of the pulsilogium and of the way that it should be used by the physician. Apart from helping the memory of the physician, it had two other uses: the pulsilogium will help the physician to distinguish between the times when the patient is ill and healthy, and it will also help in differentiating between a weak and an unhealthy pulse, these being differences of the pulse which often deceive doctors for they confuse the weak with the unhealthy pulse. The unhealthy pulse-beat does not return quickly in fevers, the weak pulse does, but if the return is slight, it will not be perceived by doctors without the instrument "and shamefully they are deceived in prognosis" ("et in praedicendo turpiter hallucinantur.") ⁽⁷⁾ Sanctorius has pointed out that it is the perception of the physician which is in doubt and which can be helped by an instrument.

The categories of medical theory into which those perceptions can be placed are not in doubt, nor is it the purpose of the pulsilogium, by elucidating the phenomena, to test in any way the explanatory theory. Rather, the contrary is the case, for the pulsilogium is used to confirm that the doctor's diagnosis of the patient's symptoms has been placed accurately in a particular category of Galenic medical theory.

This is made even clearer when Sanctorius deals with the thermometer. He wrote:-

"The second figure is a vitreous vessel by which we can very easily mark each hour the cold or warm temperature and know perfectly every hour the amount the temperature recedes from its natural state as measured previously. Which vessel is proposed by Hero for another use. We have, in fact, adapted it for judging the warm and cold temperature of the air and of all the parts of the body and for distinguishing the degree of heat in fever." (8)

Sanctorius gave instructions for the use of the thermometer as he did with the pulsilogium, and added:-

"we infer if the patient is getting better or worse which, if the differences [between the two states] are slight [then] they are not at all capable of perception by doctors without the instrument, and so they are deluded in diagnosis, prognosis and cure"⁽⁹⁾
(My italics).

The hydrometer is the third instrument. This as with the previous two can help in distinguishing between categories of disease. In this case we can decide with its help whether patients are suffering from a wet or dry illness⁽¹⁰⁾ by the way the instrument, a cord, shrinks or expands in wet or dry air.

The fourth instrument is not really an instrument, but

rather the method of weighing the amount of insensible perspiration. This, wrote Sanctorius, was contained in the aphorisms of a previous book (the Statica).⁽¹¹⁾ It is important to the interpretation of the Statica which is given below to remember that Sanctorius saw his method of weighing as having the same purpose as his other instruments; namely to get rid of conjecture in medicine and to elucidate the symptoms of the patient.

In the Commentary on the Canon Sanctorius clearly shows that he was aware that he was working within the framework of Galenic medicine. His stress on the need for exactness stemmed from the Galenic method of treating an illness by a remedy having the opposite quality to that of the illness. Sanctorius wrote:- "In the calculation of the quantity of remedies medicine is conjectural as Galen teaches." He then quoted various writings of Galen in which Galen states that the quantity of a remedy makes the art (of medicine) conjectural. Again, Sanctorius cited Galen to the effect that if the remedy is less in degree it will not cure, if greater it leads to the contrary illness and so it is difficult to invent completely equal remedies. Galen says equal, because as wrote Sanctorius:- "the doctor does not wish to conquer but to moderate and temper, would that the duty of the doctor were to vanquish, medicine would then be very easy."⁽¹²⁾ The doctrine of curing by contrary (a hot illness by a cold remedy) necessitated, in Sanctorius's mind, exactness in the perception of the qualitative symptoms of a disease. The

generic terms 'hot' or 'wet' will not do, for there are gradations of heat and wetness in the quality of a disease and in the efficacy of its remedy. If the physician were to make the correct diagnosis of a disease and to find the remedy with an exactly opposite quality⁽¹³⁾ then he needed technical aids to supplement his sense perceptions.

The purpose of the instruments that were described by Sanctorius should now be clear. They were to be used to make more certain what was conjectural in the calculation of the intensity of diseases and their qualities. Sanctorius also posed the problem of the uncertainty of knowing how strong a remedy was or what was the nature of the remedies' constituents, but he offered no instruments to solve the difficulty.

The idea of quantification, contained in the use of the instruments, involves no heuristic approach at a fundamental level. Sanctorius was not trying to find out if Galen's theories of disease were correct but rather to make the symptoms of a patient and the perception of them clearer and more accurate. The idea of measurement involves the concept of 'indication', that is, it indicates to the doctor the category of illness and the form of its treatment, the category and form being those supplied by Galen.

In his own mind Sanctorius was trying to remedy a deficiency which he felt had been recognised by Galen. The instruments of precision did not bring a quantitative basis to research as Castiglioni stated, for there was no research

involved. It is as if a general practitioner used a microscope to find out if a patient had a well-known disease while a research worker was using the same microscope to discover the nature of a disease de novo. Here Sanctorius is the general practitioner. The novelty of Sanctorius lies in his advocacy of instruments to aid the physician in routine work. Sanctorius gave other, more philosophical reasons, in the Methodi Vitandorum Errorum why accurate experience could not be used to derive theoretical or universal knowledge. These will be discussed later. Sanctorius's own description of what he was doing fits well with my thesis that it is the details of the outside world and not the theories explaining that world which are doubtful and can be questioned. Procedures or techniques were introduced by Sanctorius which may have been similar to those, to put it roughly, of modern science; however, they were not used in the same way. Although Sanctorius was working in a different field of medicine his explicit attitude to experience is analogous to the attitude implicit in the work of the² anatomists when relating observation to theory. Basic theory was not put in doubt by better knowledge of the appearances.

The Ars de Statica Medicina

The Statica can be interpreted in the same way as the procedures of measurement in the Commentary to the Canon. For, as has been mentioned, Sanctorius himself considered his statical experiments as serving the same purpose as his

three instruments, the thermometer, pulsilogium and hydro-
 meter. Nevertheless, the Statica is a rather difficult
 book to deal with. The fact that it was reprinted very
 often in the early 18th Century when the mechanistic and
 quantitative biology derived in different ways from Descartes,
 Harvey and Bacon was in full flow might make^s it difficult
 to say that the Statica was part of the qualitative theory.
 I shall show, however, that the ambiguous position of the
Statica was understood by at least one person in the eight-
 eenth century, namely John Quincy, who translated the Statica
 in 1712 and realised that the theoretical basis of the
Statica was Galenic and not mechanical. The Statica consists
 of a collection of Aphorisms into which the results of Sanc-
 torius's experiments are distilled. In the Preface to the
 Reader Sanctorius briefly summarised his achievements:-

"It is a thing new, and not before heard of,
 in Medicine, that any one should be able to find
 out the exact weight of insensible perspiration
 . . . I am the first that has essay'd it and if
 (I am not mistaken) brought the art to perfection,
 by reason, and the experience of thirty years . . ." (14)

In fact, Sanctorius was not so novel for Nicholas of Cusa
 had written down a thought experiment along the lines of
 weighing insensible perspiration in the fifteenth century,
 but he did not put it into practical effect. (15) The two-
 fold purpose of the Aphorisms, that of indicating illness
 and of giving advice towards achieving the golden mean of
 health, is introduced in "The Account of Weighing Chair." -

"From which chair we gain two advantages: the
 former by finding out the daily insensible pers-
 piration of our bodies, which perspiration not

well consider'd Medicine proves vain and ineffectual: for all indispositions almost are the production of a lesser or larger perspiration than is requisite.

The latter, in that, having seated ourselves in this chair, we perceive, during our refection, when we are come to that just proportion of meat and drink, beyond which, or short of which, we are prejudic'd." (16)

Sanctorius began the Statica proper by giving the general principles upon which his use of the weighing of insensible perspiration is based. The first seven aphorisms introduce most of the important elements of the Statica. The first aphorism gives the principle of equilibrium in the most general terms:-

"If there daily be an addition of what is wanting, and a subtraction of what abounds, lost health may be restor'd and the present preserv'd." (17)

The second aphorism adopts the same tone as did the Commentary on the Canon where Sanctorius spoke of the physician as deluding himself if he did not use an instrument so that he could correctly judge a patient's state:-

"If a physician, who has the care of another's health is acquainted only with the sensible supplies and evacuations and knows nothing of the waste that is daily made by insensible perspiration, he will only delude his patient and never cure him." (18)

The next aphorism stresses that only exact knowledge of the loss or gain of insensible perspiration will enable one to know when and how much to eat. In the fourth aphorism Sanctorius stated that:- "Insensible perspiration alone, discharges much more than all the servile evacuations together," so emphasising the importance of insensible perspiration. (19)

The fifth aphorism describes how insensible perspiration is extruded:-

"Insensible perspiration is either made by the pores of the body, which is all over perspirable and covered, with a skin like a net; or it is performed by respiration thro' the mouth, which usually in the space of one day amounts to the quantity of half a pound, as may plainly be made appear by breathing upon a glass." (20)

The sixth aphorism, in the same was as the fifth gave a constant quantity, gives a constant proportion:-

"If eight pounds of meat and drink are taken in one day the quantity that goes off by insensible perspiration in that time, is five pounds." (21)

However, the seventh aphorism contradicts the implicit idea of a constant weight or proportion contained in the previous aphorisms. It is a recurrent theme in Sanctorius's work that no general rules can be derived from individual cases. Sanctorius wrote:-

"The quantities insensibly perspir'd, vary according to the differences of constitutions, Ages, Countries, Seasons, Distempers, Diet and the rest of the non-naturals." (22)

The other sections of the Statica are devoted to the six non-naturals - Air and Water, Meat and Drink, Sleep and Vigilance, Exercise and Rest, Venery and the Affections of the Mind. The aphorisms in these chapters give general explanatory principles showing how insensible perspiration is affected by particular situations. For instance in the section on Air and Water, aphorism IX states:-

"If in a warm Season a cold day happens in the space of that day, supposing the way of living to be the same, about a third part of the perspirable matter will be obstructed: which unless it be diverted by some of the sensible evacuations, will be disposed to putrefaction, and disorder the whole constitution," (23)

Or again the tenth aphorism of the section on Venery holds that:-

"The immediate injury of immoderate Coition is a refrigeration of the stomach; but afterwards an obstructed perspiration from whence easily arise palpitations in the eye-brows and joints and then in the more noble parts." (24)

How Sanctorius arrived at these principles or maxims is a moot question. John Quincy in 1720 wrote that Sanctorius grounded his conclusions only upon sensible evidences and facts. (25) However Sanctorius, as we shall see, wrote in the Methodi Vitandorum Errorum that principles cannot be derived from experiences. In the Statica itself Sanctorius gave no information as to how he had produced the aphorisms.

It is clear that Sanctorius did not intend to propound a new system of medicine to replace Galen's. When Hyppolito Obicio, a believer in astrological medicine, wrote Staticomastix, a collection of aphorisms attacking the Statica, Sanctorius replied in another set of aphorisms, published as the Responsio ad Staticomasticem. To the charge that he was ungalenic Sanctorius answered,

"Galen made no mention of Statick medicine, therefore 'tis a vain science. He is doubly mistaken; first, because he never read his six books De tuenda, etc. Secondly, it does not follow Galen said nothing of it, therefore it is vain: we have found out many instruments (nos plura instrumenta) and those not contemptible, which were not known before our times." (26)

It is significant that Sanctorius viewed the Statica in terms of an instrument, as he did in the Commentary on the Canon. The aphorisms helped the doctor in the aim of achieving greater exactness in diagnosis and cure. The weight of

insensible perspiration, its gain or loss in different situations, would help to indicate to the doctor the internal state of the patient's body.

In some of the aphorisms there are explicit references to Galenic theory. In the twentieth aphorism of the first section Sanctorius wrote that:-

"There are two kinds of insensible perspiration the one is during sleep, of humours that are well digested . . . the other is when awake and arises from ingested humours . . ." (27)

John Quincy, who in 1720 wrote an expanded introduction to his translation of the Statica, clearly saw the old-fashioned theoretical basis of the Statica. Quincy was an enthusiastic advocate of the mechanical philosophy in biology, and wrote:-

"And of this I have hopes in a great measure of succeeding by demonstrating that those rules and laws of motion which we are furnished with from Mechanics, are the only guides we can have in discovering the Natures and Properties of all material substances whatsoever . . ."

Quincy realised that the mechanical philosophy had not taken root in Sanctorius's generation:-

"although he (Sanctorius) composed those aphorisms at a time when this way of reasoning was but very little made use of in physick, and seems to have had very little regard for it himself; yet the means of information he hath herein used, have so steadily guided him throughout the whole, that there is but very little advanced but what is conformable and applicable thereunto" [i.e. the mechanical philosophy]

Nevertheless, Quincy felt that despite Sanctorius's non-mechanistic beliefs he had managed to achieve a large degree of "non theory-ladenness" in the aphorisms by "grounding his

conclusions only upon sensible evidences and facts." (28)

It is with a good grasp of history but perhaps with a naive belief in the ideas of his own time that Quincy wrote of Sanctorius's theoretical beliefs:-

"Sometimes indeed he is very apt to lay hold of his systematicall helps; but it is very remarkable, that he is never more obscure than at such times. He lays down his matters of fact upon such evidences as cannot deceive; but when sometimes he goes farther, and gives Reasons, why it is so, he is hardly to be understood. As when he tells us, that Cold strengthens robust constitutions, but weakens those who are infirm, there is no body can doubt of the truth of it, but when he gives his reason, that cold drives the natural heat to the center, in the former and exhales it in the latter, I believe there are very few e'er the wiser." (29)

Quincy saw the crucial point: the new technique of weighing insensible perspiration was not used by Sanctorius as a means of arriving at a new theory of medicine. Sanctorius remained in the context of the old world. The opinion of Quincy is the more worthwhile as he is an advocate of the theory which came next and which replaced Sanctorius's (at least in principle). Quincy saw that the application of quantitative techniques did not imply a quantitative theory - an error which has been made by some modern historians. As in the case of the anatomists so with the Statica, the emphasis on exact observation of the phenomena does not mean that the explanatory basis of the appearances is affected. The appearance of induction may be there, but is only a phantasm of the future.

Sanctorius on Experience and Knowledge

Apart from the description of the weighing chair Sanctorius gave no explanation in the Statica of the nature of his experiments. In the Preface to the Reader, he wrote only that he carried out the experiments over the space of thirty years and that he assimilated them in his mind into aphorisms in the same way as a bee forms the wax of the hive into the most economical and regular shape.⁽³⁰⁾ The conventions of experimental science by which a scientist convinces his profession of the correctness of his work are not to be found in the Statica. Sanctorius did not feel the need to give details of his experiments so that others might check them and be convinced. One might suppose that at this time there were no such conventions, so there is little point in asking why he did not supply details.

However Sanctorius explains himself further. In the Methods for avoiding all the errors which touch on the art of medicine, he defined the limitations of experience in such a way that protocols for experiments would be redundant. In effect Sanctorius stated that experience or experiments (he uses both words indiscriminately) were useless for logically deriving a universal statement or theory and that particular instances could not be generalised with impunity. I will first consider the passages where Sanctorius discussed experience and knowledge. Then I will discuss the general nature of the Methodi Vitandorum Errorum; for the

book is the clearest expression of the belief of Sanctorius in the pre-eminence of categories.

The twelfth book of Methodi Vitandorum Errorum is concerned with examining the use of analogy and experience. Chapter six of this book is entitled:- "It is shown from analytical principles that experience is fallacious and dangerous."⁽³¹⁾ The title echoes the first Hippocratic aphorism⁽³²⁾ which stressed the fallacy of experience and probably it was influenced also by Galen's dislike of the Empirical school to which Sanctorius, as a loyal Galenist, gave abundant vent in his book.

Sanctorius started by quoting the authorities of his own subject:- "Now it is known from Hippocartes and Galen that experience is fallacious and dangerous." He went on to say that "now we show by higher principles the fallacy of experience."⁽³³⁾ He argued first that by the nature of syllogistic reasoning experience is false:-

". . . all experience is acquired through induction or example, but as it is that induction and example are reduced to a false syllogism, therefore the experience will be fallacious." (34)

After quoting Aristotle that from one example we cannot, by syllogism, produce a universal conclusion, Sanctorius went on to consider the difficulties involved in induction. He is very clear on the subject:-

"Further, when experience shall be collected from particulars it is not conclusive because out of pure particulars nothing follows. And do not object that experience is not collected from two particulars but from many; because we reply that

if you gather it from a thousand, you are not able to infer a universal conclusion, or rather if you induct through a thousand thousand, still you cannot derive a universal conclusion, since each species of the universal contains in itself infinite particulars." (35)

From this definition of a universal Sanctorius argued that to produce a universal, logically from particulars, one would need an infinite number of instances; which is impossible for mortal man. (36) Sanctorius also added that experience in itself contained no synthetic capability to produce general conclusions for "experience, since it happens to proceed from a singular to a singular, is not able to conclude anything." (37)

The problem of how a universal can be produced by man was introduced by Sanctorius when he discussed a possible objection to his view of induction. He wrote that there was a great doubt, concerning his conclusions about induction, for by the authority of Aristotle when one particular remains in the memory, then it begins first to be a universal in the mind, but as particulars are conserved in the memory by virtue of induction or experience, therefore induction or experience may produce universality. Further, experiences are seen to produce recognition of causes and demonstration 'quia' (why), and this is because recognition of causes is a universal, therefore experiences lead to a universal and this is confirmed by many examples. The two examples given by Sanctorius are that ^aguaiacum is the cause of the cure of syphilis and rhubarb of bile. ^h(38) Sanctorius answered the general

objection first. When the particular in the memory begins to be a universal in the mind this is because in every particular there is included its total universal nature, and it is the intellect and not experience or induction which separates a universal from singulars by its own proper light ('Intellectus separat universale a singularibus suo proprio lumine').⁽³⁹⁾ This was in fact the traditional Aristotelian view expressed in the Posterior Analytics where Aristotle states that the truth of a universal middle term can only be grasped by the power of the mind and not by logic.⁽⁴⁰⁾ The example that Sanctorius gave to illustrate the fact that a particular contains a universal was the stock case in which any and every man contains in himself the species man and the mind separates from the individual the concept of mankind.⁽⁴¹⁾

Sanctorius then replied to the objection posed by the two examples where a universal conclusion seems to be derived from experience. He stated that these were not universal propositions but only indefinite ones. Thus only some ^aguaiacum cures syphilis and only some with syphilis are cured ^a by ^aguaiacum.⁽⁴²⁾ Sanctorius took the consequences of his view of the limitation of experience to their logical conclusion. He wrote:-

"Secondly, while they say that experience, since it proceeds from effects to causes, is demonstration a posteriori concerning the reason for the way things are, so it produces a universal. We reply that experience does not proceed from effects to causes, but from effects to particular and indefinite subjects." (43)

What Sanctorius is saying is that experience itself cannot demonstrate a universal proposition. It can only confirm one particular instance, or, once it ceases to be applied to a single instance, it will only prove some indefinite instances. Thus a universal proposition which, if it is to be proved, must be shown to apply to both one and every specific instance cannot be proved by experience. This point of view may perhaps have some slight resemblance to the hypothetico-deductive models of present day philosophy of science.

However Sanctorius drew back from the abyss of Plato and Sir Karl Popper. He did find a use for experience:-

"We do not deny, however, that induction or experiments ('experimenta') can contribute towards knowing a universal; because, as Boethius said in [his commentary on Aristotle's] Categories, experience is the collection of examples, after the collection the intellect is urged on by its own light to separate the natural universal from the individual, for the whole universal nature is in any individual." (44)

Sanctorius also repeated the opinion of Averroes that induction infers the recognition of universals from accidents because the collection of many examples frequently place before the intellect a universal which is included in every particular. (45) Sanctorius is really arguing about the suggestive power of experience. His position is essentially Aristotelian but in his tone he is stressing the Platonic part of Aristotle; experience is the matter with which the mind works but it is not infallible matter, the mind itself must grasp the reality out of the appearances.

There should now be no difficulty in understanding why Sanctorius gave no details of his experiments in the Statica. The truth of the experiments cannot be derived logically for only the light of the mind can grasp it. Therefore the principles of the Statica must, in an almost Cartesian manner, be either totally self-evident or not evident at all.

Again, this analysis of experience and knowledge explicitly separated, at least logically, observational experience from theory. This view, as will be seen in the next chapter, was not held by Sanctorius alone but formed part of the arguments concerning medical method developed by Leonicensis and his successors. The fact that there was an explicit separation of observation and theory and that this was reasonably widely held gives point to the conclusions of my analysis of the work of the anatomists.

Categories and Signs

The argument about experience and knowledge was not the major topic with which Sanctorius was concerned in the Methodi Vitandorum Errorum despite its interest for this thesis. If we consider the book as a whole it is possible to grasp what Sanctorius really meant when he talked of medicine. The Methodi Vitandorum Errorum is a very large work which can best be seen as a greatly expanded set of lectures teaching accuracy in medicine. In the Preface to the first Book Sanctorius stated:-

"I think that it is established that in the art of curative medicine infinite errors can be made, either in the recognition of disease, or of cause, or in the contrivance of aids, or in prognosis or finally in the administration of remedies." (46)

The problem that concerned Sanctorius is similar to that propounded in the Commentary on the Canon. There it was conjecture in measurement; here it is all types of error. But in both cases the diagnostic and therapeutic^e capability of the doctor is in doubt. Sanctorius considered various ways of achieving certainty in medicine. The method which he favoured most was that from the running together or collection of signs or symptoms ('per syndromen signorem').⁽⁴⁷⁾ The book begins by giving the most general classes or genera of symptoms and then descends to more specific cases. From the appended tables⁽⁴⁸⁾ it can be seen that, as Sanctorius himself wrote, the forms and ideas are the 'generating' parts of his system; the symptoms from disease are subordinate. When Sanctorius wrote that "all the proper signs of bad humours can be reduced to three headings",⁽⁴⁹⁾ he did not mean that the categories were derived from the signs, for he quoted Galen as saying that there were four types of phlegm etc., thus the categories are derived from the theories of the ancients. The language of signs and symptoms might imply an empirical approach but in fact the opposite is the case.

If the doctor can recognise the signs and correctly place them in their category he will not go wrong. This is what happens today in medical training. The student is not taught how to produce new discoveries but rather to discern the

patient's symptoms and to relate them correctly with the present state of medical knowledge. If the teacher is excessively sceptical about the value of the basic knowledge that he teaches the student loses confidence. For Sanctorius, medical knowledge or truth was contained in his Galenic categories which in turn supplied the symptoms or signs. However, the analogy cannot be taken too far. Sanctorius made claims in the book which went beyond teaching. He conflated the achieving of universal truth with current theoretical knowledge. Not every Cartesian went through the same process of meditation as Descartes, for Descartes had done the work for him. Similarly, although Sanctorius described how one acquired true universal knowledge, he did not feel the need of forming anew the foundations of medicine; for Hippocrates, Aristotle and Galen had done the work for him. Also, there is another consequence of an a priori view of knowledge. One must have some a priori knowledge to exhibit, for otherwise how does one convince others that there is such a thing as a universal? For Sanctorius traditional Galenic medicine was his example of the existence of such knowledge.

The emphasis on the way signs have to be placed in their correct categories and the implication of the inviolability of those theoretical categories is again analogous to the work of the anatomists. The observations fit the theories and the really basic theory is not changed. That Sanctorius could write a teaching treatise and also write about the creation of knowledge without producing contradictions is another sign of the static nature of his questioning of basic theory.

Conclusion

Sanctorius, in a sense, provided a sufficient description of the nature of his work. In his writings the overpowering influence of Galenic theory can be appreciated. If we view history as progress, then perhaps Sanctorius's description of the status of medical knowledge should be ignored. To do so however would be to miss an opportunity of gaining an insight into an age which was developing the techniques and language of the next generation but which was firmly embedded in the thought of the ancients. In the next chapters we shall see how Sanctorius is typical of the writers on medical method. The present chapter should have shown how the most advanced developer of techniques of quantification in medicine in this period denied the possibility of induction. Moreover, it should be apparent that Sanctorius felt that his new techniques were not a means of overthrowing Galen and the ancients but that they were to be used to help make the judgement of the doctor more precise when placing a patient's symptoms into their appropriate explanatory theory or category.

CHAPTER VIPLATO TO LEONICENO, SOME ATTITUDES TO METHOD

In the previous chapter I examined the opinions of Sanctorius concerning medical knowledge. Those views stressed the importance of categories, definitions and aphorisms and placed limitations on the use of experience. In the present chapter I want to show that the position of Sanctorius was not an isolated one, but may be seen as part of the debate centred on the question of method originating in Galen's Ars Parva, which had been given fresh importance by the work of Leoniceno and Montanus in the fifteenth and sixteenth centuries respectively. To deal adequately with the issues which were raised by the Ars Parva for writers on the theory of medicine in the renaissance it is necessary to consider some of the classical authorities on method, for the writings of Leoniceno and Montanus cannot be understood without this background nor indeed can the Ars Parva. I shall emphasise particularly that thread running through the ancient and renaissance discussions on method in medicine which relies on knowledge obtained without previous reference to experience.

I shall then examine Leoniceno's explanation of the Ars Parva after having given first a description of the treatise itself. It will be seen that the separation by Leoniceno of 'order' from 'method' emphasised the static and definitive aspect of knowledge in contrast to analytical and creative approaches to science. The elaboration of Leoniceno's work

by Montanus into a coherent doctrine of knowledge will be described in the next chapter.

The Problem of Method in an Art

In this section of the chapter I shall describe the ambiguities and difficulties contained in the classical development of the idea of method. I have drawn upon Neal Gilbert's excellent book Renaissance Concepts of Method⁽¹⁾ as a guide through this early period, though the analyses of passages from Plato and Aristotle are my own.

There was no single unifying idea of method during Greek times. The Socratic discussions about method in the Phaedrus dealt more with techné or art than with science and more with the formal rules of composition of an art and its teaching than with methods of discovering knowledge. Aristotle did discuss method in relation to science. However, the meaning of the concept of method varied according to the purpose of the particular treatise involved. Finally there was the Stoic idea that method was a series of 'percepts' which gave the essence of an art and which, if learnt, would teach the art itself.

The etymology of the word 'method' contains some of the varied meanings that the word was to acquire. The dictionary derives the word from the Greek 'Μεθόδος'. It is compounded of 'μετά' and 'ὁδός' meaning 'following after'. ὁδός also means 'way' or 'path' so that the more concrete sense of 'after a way or path' is possible. A path

can be seen as leading to an end or discovery whereas 'following after' has the sense of logic or the steps of an argument. This dual meaning was brought out and preserved in Cicero's translation of the Greek as 'via et ratio'.⁽²⁾ Cicero's rendering was often used in the renaissance and can be found for instance in the Epitome of Vesalius.⁽³⁾

The Socratic dialogue, the Phaedrus, displays some of the meanings of method and was one of the most important sources for the development of the idea of method in science and art. In the Phaedrus, method was discussed by Socrates in terms of the art or techné of rhetoric and medicine. There was a passage however which was seen by later commentators, including Leonicensio, to apply to knowledge both in art and science.

In this passage Socrates, describing to Phaedrus the two principles of definition and division necessary in rhetoric, stated:-

"First [there is] the comprehension of scattered particulars in one idea; the speaker defines his several notions in order that he may make his meaning clear, as in our definition of love, which whether true or false certainly gave a clearness and consistency to the discourse . . .

"Secondly, there is the faculty of division according to the natural ideas or members, not breaking any part as a bad carver might. But as the body may be divided into a left or right side . . .

"I am a great lover of these processes of division and generalisation; they help me to speak and think. And if I find any man who is able to see unity and plurality in nature, him I follow and walk in his step as if he were a god. And those

who have this art, I have hitherto been in the habit of calling dialecticians; but God knows whether the name is right or not." (4)

The way that Socrates praised these two principles, his equation of them with "the unity and plurality of nature" and his use of the term 'dialecticians' meant that definition and division were seen later on not only in relation to rhetoric but also as the principal subdivisions of dialectic. The term dialectic in this context means, I think, the correct way or method of thinking and speaking about nature and knowledge.

A little later in the Phaedrus the point is made that in order to be able to teach an art or to say that one is master of an art, more than unconnected pieces of knowledge are required:-

Socrates:... Suppose a person to come to your friend Eryximachus, or to his father Acumenous, and say to him: "I know how to apply drugs which shall have either a heating or a cooling effect, and I can give a vomit and also a purge, and all that sort of thing; and knowing all this, as I do, I claim to be a physician and a teacher of physic" - what do you suppose they would say?!

Phaedrus: They would reply that he is a madman or a pedant who fancies that he is a physician, because he has read something in a book, or has stumbled on a few drugs, although he has no real understanding of the art of medicine." (5)

The need for the physician to be able to answer the questions 'when' and 'how much' meant that the art of medicine was a connected whole. It had a rational structure and was not a random or empirical collection of experiences.

How "real understanding" of an art can be achieved is gradually brought out in the dialogue. Socrates stated that

if true artists like Adrostus and Pericles heard Phaedrus and himself castigating ignorant artists they would say:-

"Have a little patience . . . and don't be angry with those who from some want of dialectical skill are unable to define the nature of rhetoric and consequently suppose they have found the art in the preliminary conditions of the art, and when they have taught these to others, fancy that they have been teaching the whole art of rhetoric." (6)

Socrates has introduced here the idea that the true artist knows the nature of his art when he is able to define it and that this is, indeed, a sign of his mastery of his art. The close association between the ability to make a definition of an art and having true knowledge of the nature of an art was strengthened when, in a crucial passage of the Phaedrus, Socrates answered Phaedrus's question, "where and how the true art of rhetoric is to be acquired?" (7) After saying that a natural gift for oratory is necessary, Socrates added that "this is assisted by art", and he continued:-

Socrates: Rhetoric is like medicine.

Phaedrus: How is that?

Socrates: Why, because medicine has to define the nature of the body and rhetoric [that] of the soul - if you would proceed, not empirically but scientifically, in the one case to impart health and strength by giving medicine and food, in the other to implant the conviction which you require by the right use of words and principles." (8)

Socrates again emphasised here the rational nature of medicine; though by comparing it to rhetoric he gave his authority to the idea that medicine was an art and not a science. This was important, for it meant that later on when method in

medicine was discussed it was rather in terms of the language used to define art than in terms of the dialectical tools of Aristotle.

However, in this passage Socrates also stated that since the end of medicine is to impart health it is necessary to know the nature of the body. There is the implication that the purpose of an art must be known before one can proceed to define its nature in terms of its constituent parts.

This was brought out more clearly by Socrates when he asked:-

"Socrates: And do you think that you can know the nature of the soul intelligently without knowing the nature of the whole?

Phaedrus: Hippocrates the Asclepiad says that this is the only method of procedure by which the nature even of the body can be understood.

. . . Socrates: Then consider what this is which Hippocrates says and which right reason says about this or any other nature. Ought we not to consider first whether that which we wish either to learn or to teach is simple or multiform, and if simple, then to inquire what power this has of acting or being acted upon by other, and if multiform, then to number the forms, and see first in the case of one of them, and then in the case of all of them, the several powers which they by nature have of doing or suffering." (9)

To know and to be able to define the nature of the whole body involves the process of division. Whether definition precedes or comes after division was a question raised in the renaissance. It appears to me that Socrates meant that first one defines the end of an art, then considers in what way the terms of the definition can be divided and finally one describes the nature of the terms given by division.

This in fact is what Montanus was to conclude, not when discussing Socrates, but in his Commentary on Galen's Ars Parva. In this way both the general and the detailed nature of an art can be known and also the "unity and plurality", which Socrates hoped to find in nature by definition and division, can be discovered in an art.

Socrates underlined the importance of the method that he had described when he said:-

"The method which has not this analysis is like the groping of a blind man. Yet, surely, he who is an artist ought not to admit of a comparison with the blind or deaf; but he who imparts rules of speech in an artist-like or scientific manner will particularly set forth the nature of that to which he gives his rules, which I suppose is the soul." (10)

Apart from using the image of method as a guiding way Socrates also made the point that the rules of an art contain in themselves the nature of the art. The end of rhetoric is to persuade the soul, and the rules of rhetoric will include the purpose of rhetoric of which the soul is part. So when, in order to convince the soul, rhetoric is expressed by its proper rules, the rules themselves will contain the nature of the soul and thus be able to reach the soul. This concept was further developed in the Stoic idea that the percepts of an art (that is sense impressions or more broadly the elements of experience) could be collected to give the nature of the whole art.

The passages from the Phaedrus are important for later debates on medical method because they stress the importance of definition and of knowing the whole nature of an art.

This together with the view that the rules of the art express the art itself is the foundation for the view that a prior definition of the structure of the art of medicine, whether expressed by aphorisms or categories, is more important than analytical investigation. For the analysis cannot occur unless there is a previous conception of the nature of the art, otherwise there would be nothing to analyse.

The schematic nature of Sanctorius's book on the Method of Avoiding all errors which touch on the art of curative medicine can, in fact, be seen in this way. For what Sanctorius did was to give definitions of theory and then analyse them by reference to symptoms. There is no sense in which his analysis could be said to produce his definitions.

In the Phaedrus neither the discovery nor the demonstration of scientific knowledge was explicitly mentioned, but the typically Socratic aside that division and definition, "help me to speak and think" illustrates the contrast between the approaches of Socrates and Aristotle. Socrates took the tools of division and definition and applied them to the humane arts of speech and medicine, whereas Aristotle was to apply the same techniques, though more clearly defined, to the analysis of syllogistic knowledge and to the discovery of knowledge. Later commentators found this different use of similar techniques very confusing as can be seen in Leonicensio's attempt to understand what Galen meant in the Ars Parva.

Although Aristotle's work is very important for the

history of scientific method, his discussions of scientific demonstration are not so relevant for this chapter as his description of Natural Science and the final cause. The Posterior Analytics does not deal with teaching or learning a science and touches only indirectly on the issues involved in discovering knowledge. How we can judge a conclusion to be certain and how science can expand in a logical fashion are Aristotle's major concerns in this treatise. Method here is the means whereby knowledge of causes is demonstrated. The vehicle or instrument of this method is the syllogism and Aristotle wrote most of the treatise as an analysis of the syllogism.

Although the Posterior Analytics was not meant to give a method of procedure of discovery, the opening passage of the Physics could be seen as doing this:-

"In all sciences that are concerned with principles or causes or elements, it is acquaintance with these that constitutes knowledge or understanding . . .

"Now the path of investigation must lie from what is more immediately cognizable in its own nature . . . we must needs start from what is more immediately within our cognition, though in its own nature less fully accessible to understanding.

"Now the things most obvious and immediately cognizable by us are concrete and particular, rather than abstract and general; whereas elements and principles are only accessible to us afterwards, as derived from the concrete data when we have analysed them." (11)

John Randall in his article The School of Padua and the Emergence of Modern Science traced the development of the method of resolution, a method which had its origin in the

Analytics and Physics. He felt that the growth of the idea that the investigator should start his work by concentrating on particulars perceived by the senses was an important constituent of modern science.⁽¹²⁾ Randall cited many writers from Pietro d'Abano in the fourteenth century to Zabarella in the sixteenth to show that writers and commentators on logic developed Aristotle's procedure.

I mean to argue, however, that in the sixteenth century there was a current of thinking amongst writers on medical method which stressed an a priori type of knowledge which was given expression by definitions, aphorisms and the use of categories. My view and that of Randall are not mutually exclusive. Randall drew an analogy between philosophy, as developed up to the sixteenth century, and the physics of the seventeenth century. This chapter, however, is concerned more with sixteenth century ideas largely derived from Galen rather than natural philosophy as developed from Aristotle.

Nevertheless, the opening of the Physics contained more than the origins of the method of resolution. Following the passage quoted above Aristotle used the Socratic idea of definition when he illustrated how a "concrete whole" could be analysed:-

"And by calling the concrete a 'whole' I mean that it embraces in a single complex a diversity of constituent elements, factors or properties.

"The relation of names to definitions will throw some light on this point; for the name gives an unanalysed indication of the thing ('circle' for instance), but the definition analyses out some

characteristic property or properties. A variant of the same thing may be noted in children who begin by calling every man 'father' and every woman 'mother', till they learn to sever out the special relation to which the terms properly apply." (13)

Aristotle argued here that the resolution by the process of definition of a complex whole could be in terms of the categories common to its constituents. As Sanctorius put it, experience exciting the light of the mind could produce knowledge of these categories. However, Aristotle did not say that there was a logical or mechanical process of analysis which led to a knowledge of the causes and categories of the phenomena being examined. His point in the Posterior Analytics, that the truth of ultimate causes was not recognised by logic but by intuition,⁽¹⁴⁾ implied that ultimate causes could not be discovered by logic.

The necessity for accurate sense perception and its subsequent analysis is logically separate from the process whereby the power of the intellect discovers the categories and causes which explain the sense perceptions. This is analogous to the distinction, which I believe can be discerned in medicine in the sixteenth century, between the attempt to analyse and to dissect the body more accurately by sense perception and the use of categories and causes which are not affected to any fundamental degree by changes in the experiential knowledge of the body.

The Socratic element is more apparent in Aristotle's discussion of the method that he proposed to use in The

Parts of Animals. This was because Aristotle considered that he was dealing with an art, albeit his exposition of it aimed at being scientific.

Aristotle wrote that a man of general education could "judge correctly which parts of an exposition are satisfactory or not." The man who had "scientific knowledge of a subject" could judge only his special science.⁽¹⁵⁾ From this basis Aristotle was able to state that "there must first of all be certain defined rules by which the acceptability of the method of exposition may be tested apart from whether the statements made represent the truth or not."⁽¹⁶⁾

There is a very close correspondence here with what Socrates said in the Phaedrus concerning the correct way of division and definition regardless of a statement's truth or falsity. However Aristotle made the point more clearly and developed the distinction between the general method of formulating scientific argument and the specific method appropriate for investigating a particular science.

Aristotle also repeated Socrates' assertion that one must know the nature or purpose of an art before one investigates it. He asked whether the student of Nature should:-

" . . . follow the same sort of procedure as the mathematician follows in his astronomical expositions - that is to say, should he consider first of all the phenomena which occur in animals, and the parts of each of them, and having done that go on to state the reasons and the causes; or should he follow some other procedure?" (17)

Aristotle answered that:-

" . . . the method of reasoning in Natural Science and also the mode of Necessity itself is not the

same as in the Theoretical sciences . . . In the Theoretical sciences, we begin with what already is; but in Natural science with what is going to be, thus, we say, because that which is going to be - health, perhaps, or man - has a certain character, therefore of necessity some particular thing P, must be, or must be formed; not because P is now, or has been formed, therefore the other thing (health, or man) of necessity is now or will be in the future." (18)

By distinguishing between the Natural and Theoretical sciences in this way Aristotle meant that the geometer proceeds from the formal cause or what is, whilst the naturalist starts from the final cause of the formal or end product. Thus in the case of the Natural Sciences the end or purpose of the science, as health in the case of medicine, predetermines the analysis of the form of the science, because of necessity we must already know the general nature of its form.

This very clear distinction between the Theoretical and Natural Sciences placed severe limitations upon the role of analysis or resolution. Analysis of "what already is", can enable us to reach the cause of the thing. However, because we start with the cause of the thing in Natural Science the analysis of the thing itself will be merely tautological, or at best a filling in of detail. In ^{is} this definition of Natural Science and consequently medicine, so clearly expressed here and also implicit in the Phaedrus, which gives us a means of understanding why new observations in anatomy did not affect fundamental causal theories as much as they might have done.

The priority of the final cause in the Natural Sciences

was emphasised when Aristotle defined the final and efficient causes. He made it clear that the final cause was necessary in investigating the art of nature. Aristotle stated that we must decide whether "the Cause for the sake of which the thing is formed" or "if the Cause to which the beginning of the motion is due," is prior. Aristotle then continued:-

"Clearly the first is that which we call the 'Final' Cause - that for the sake of which the thing is formed - since that is the logos of the thing - its rational ground, and the logos is always the beginning for products of Nature as well as those of Art. The physician or the builder sets before himself something quite definite - the one, health apprehensible by the mind, the other, a house apprehensible by the senses; and once he has got this, each of them can tell you the causes and the rational grounds for everything he does, and why it must be done as he does it. Yet the Final Cause (purpose) and the Good (beautiful) is more present (19) in the works of Nature than in the works of Art."

Aristotle's association of medicine with the final cause, which echoed the Socratic comparison of the art of medicine with the art of rhetoric, helped to establish medicine in methodological terms as an art or Natural Science to be investigated by starting from its final cause or purpose. Hence we would expect any development of Aristotelian ideas on analysis or revolution to be different in medicine from those traced by Randall in philosophy and natural philosophy.

The congruence in thought between Socrates and Aristotle on the subject of medicine and its method makes the position of Sanctorius understandable. In the previous chapter he was described as subscribing to the Platonic side of Aristotle. In reality, though, Aristotle did not radically rebel from Plato in the case of medicine so that Sanctorius did not have

a choice in the matter between the 'Aristotelian' Aristotle and the 'Platonic' Aristotle.

The Stoics also influenced renaissance views concerning the nature of method and they emphasised the aphoristic or definitive nature of an art. Zeno wrote that an art was a "set of percepts exercised together toward some end useful in life." As Gilbert writes, the concept of percepts stemmed from the Stoic belief that there was a sense impression conveying the truth so powerfully as to defy its being shaken by reason.⁽²⁰⁾ Lucian's dialogue on the 'Parasite' gives an insight into what was meant by 'percepts'. An art was there defined as "a system of grasping sense impressions exercised toward some end useful in life."⁽²¹⁾

When, in medieval times, the difficult word 'perceptio' - 'percept' became by grammatical accident 'praeceptio' or 'precept' the method of an art was seen as a system of precepts or aphorisms rather than as a collection of experiential insights into the nature of an art. Allied to this change there was developed the corresponding idea of method as a short-cut or brief way. When John of Salisbury (c.1110-1180) discussed the nature of an art, he stated that "the Greeks also call it methodon", since it prepares a compendious way and thus avoids the waste ('dispendium') of nature with respect to those things which it is in man's power to produce.⁽²²⁾

Gilbert shows how a host of 'epitomes', methods and compendiums, all trying to give the essentials of a subject,

sprang up during the sixteenth century. A reaction then set in: for example Richard Montagu in his defence of tithes, written against John Selden's 'History of Tithes' (1618), in passing wrote of:-

"The Abridgements that have been made long since, and of late are held to be one of the chiefe plagues of learning, and learned men. It maketh men idle, and yet opiniative, and well conceited of themselves. He that can carry an Epitome in his pocket . . . imagineth mightily, that he knoweth much, and yet indeed is but an 'ignaro'. In a day he is taught, but to little purpose, as much as others can learne in a whole yeere. Lately the World went a madding this way, for 'Systemaes', 'Syntagms', 'Synopseis', and I know not what, both for the Handmaids and Mistresses of Arts." (23)

The medieval development of the Stoic idea of precepts into precepts allied with the Aristotelian and Socratic view that in an art its definition preceded its division was an important factor in producing a book such as Sanctorius's Method for avoiding all errors in the art of curative medicine. Although Sanctorius was more directly influenced by Galen's Ars Parva his treatise owed much to the Aristotelean and Socratic writings on the method of an art or Natural science.

Galen's Ars Parva

The Ars Parva or Liber Microtegni was a short treatise by Galen in which he attempted by means of definition to teach the art of medicine. This was the treatise whose meaning Leonicensio tried to free from the accretions of the commentators and which influenced the methodological attitude of Montanus and Sanctorius.

Before examining the work of Leoniceno on the Ars Parva I will discuss the problems raised for early commentators by the opening lines and then give a brief outline of the rest of the treatise. I have used the English translation of Nicholas Culpeper entitled The Art of Physick, printed in 1652. However, it is a rather free and enthusiastic rendering and it does not always contain some of the new meanings that the Ars Parva acquired after the work of Leoniceno. I have, therefore included some of the omissions in brackets.

The opening of the Ars Parva was the most important passage for the commentators. This stated that:-

"All the order and method of Physick, so far as concerns Order [of teaching] may be reduced to these three Heads.

1. The first consists in the notion [of the end] which is done by resolution.

2. The second consists in composition of those things which are found by this resolution. And

3. the third of the dissolution of definition. This third contains not only the dissolution of definition, or defining diseases, but also an explication, resolution, division, explanation or exposition upon them and this is the basis of our work at this time and indeed this laies down the way and order to the whole practice of Physick, and truely excels the other two as much as the light of the sun doth the light of the moon (especially, in that it is short and easily memorised)." (24)

Commentators before Leoniceno tried to identify Galen's three orders of teaching with the four subdivisions of dialectic (division, definition, demonstration, resolution). The crucial words in the Greek were, "διδακτικὰ τὰς ἐν" in the first sentence. These literally mean 'teaching in

order' or procedures of teaching. But the terms resolution and composition sounded too much like the terms of dialectic to the medieval commentators and so they ignored the word "TaxEWS" or 'ordo' which emphasised that Galen intended to describe various orders or procedures of teaching.

The description of the three orders of teaching contains a mixture of previous ideas, but there is a certain thread running through it. The first order, which stated that the notion of the end of the art could be reached by analysis, was related to the Phaedrus passage on the need for a definition of an art and also to Aristotle's analysis of the method of Natural Science and the final cause. The second order is dependent on the first, but it appears to resemble the method of composition developed by the Paduan philosophers from Aristotelean dialectic.

The medieval commentators were struck by the term 'resolution' and sought to identify it with the method of syllogistic demonstration by analysis (or resolution) contained in the Posterior Analytics. The use of the word 'composition' in the definition of the second order made the commentators' attempt more plausible. For in the Phaedrus tradition it is possible to understand how by analysis of the constituents of an art one can reach a notion of the end of the art. However, it is difficult to see how one is able to compose back the constituents of the art from the notion of its purpose in a way different from the 'dissolution' of definition of the third order. Therefore, it appeared to the commentators

that Galen was describing the resolution of particulars into universal causes and the converse composition of particulars from universals - in other words the Paduan method of resolution.

However, I think it more correct to see the Ars Parva in the tradition of the Phaedrus and the Parts of Animals rather than in the Aristotelean dialectic tradition. For the third order corresponds very well to the description that Socrates gave of the division of definition in the Phaedrus. The sequence of Galen's orders also re-inforce the impression of his debt to this tradition. For he starts with the end or final cause and proceeds to divide the definitions of the art. There are thus two types of analysis or resolution: with the first the purpose of an art is understood, with the second the particulars of the art are filled in by analysis of definitions or categories. The first is more investigative and synthetic than the second which is more nearly tautological, but both were necessary for teaching.

It was, in fact, by definition that Galen tried to express and teach the art of medicine in the Ars Parva. Chapter two of the treatise opened with the statement that: "Medicine is the knowledge of things healthful, not healthful and neutral", and continued by resolving this definition, "but things healthful, unhealthful and neutral carry each of them a three-fold signification viz. as a Body, as a Cause and as a Sign."⁽²⁵⁾ Thus the signs of unhealthful things are described:-

"The body surprized and seized by a disease, the cause, which causeth and continueth this disease, and the indications or signs which give testimony what this disease is" (My italics). (26)

The treatise then went on to give the various definitions of "Such bodies as are healthful, unhealthful and neutral" and similarly for Signs and Causes. (27) The definitions that followed started from the general and descended to the particular. For instance Chapter Four stated that:-

"A body is simply said to be healthful when it is in good natural temper, when the seven natural things viz. Spirits, Elements, Complexions, Humors, Members, Vertues, Operations keep a good decorum, then is a body simply said to be in health." (28)

Whereas in the section on Signs, after they had been generally defined, we learn more particularly that:-

"A very small head is a proper indication of a vicious brain, and yet a great head doth not necessarily declare a strong brain." (29)

This method of definition by which other more particular definitions, resolve, analyse or explicate the more general definition was the origin of the Methodi Vitandorum of Sanctorius. For, as was seen in the previous chapter, the method from signs which Sanctorius developed was essentially a filling in of general categories of diseases with more specific categories, together with a description of the signs or symptoms by which these categories could be recognized.

In the Ars Parva, Galen described the difference in procedure between the theory and practice of medicine:-

". . . And here we must also make a difference between Science and Action; or if you will between the Theoretical and Practical part of Medicine. For

1. The Theory regards first the cause of things healthful, then of unhealthful; lastly, of things neutral: after this of bodies, first, healthful, then unhealthful, and in the last

place neutral; and it walks by the same rules in signs or indications. But

2. In Actions or Practice, the knowledge of the body is the first thing which is minded, and this is found out by the signs and the last search (in respect of time) is after the cause." (My italics) (30)

This passage expresses very well the anti-empiricist element which was to be developed by the later writers on medical method. Theory treats first of causes, then bodies and finally signs or symptoms. The sequence gives a clear implication of the a priori nature of theoretical investigation in medicine and bears some analogy with Aristotle's procedure for investigating the natural sciences. The emphasis on empirical priority in the practice of medicine is a recognition that when examining a patient, the doctor first examines the patient by looking for symptoms and as Galen wrote "in respect of time" the cause of the disease comes last. However, the investigation of signs would have been pointless if the causes for the signs were not previously known.

The Ars Parva was, in fact, set out according to the order of practical medicine. That is, Galen dealt first with bodies, then with signs and finally with causes. That was, however, merely in a formal sense; for in order to make any meaningful statement about bodies or signs he had constantly to use definitions which were, essentially, causal statements.

The Ars Parva was important for renaissance discussions of medical method because it emphasised the a priori nature of medicine and the need to know the final cause. The content

and the way the treatise was set out certainly influenced Sanctorius when he wrote the Methodi Vitandorum and also influenced the Medicina Universalis of Montanus. However, the Ars Parva was important because of the problems that it raised. To understand the opening of the Ars Parva meant that the Socratic and Aristotelean influences on Galen had to be considered as well as Galen's own words. Thus the debate on the meaning of the Ars Parva did not involve simply a consideration of the procedures of teaching, but also included more general ideas on method in order to show what Galen did or did not mean.

The Scholarship of Leoniceno

Nicolo Leoniceno was born in 1428 and lived far into old age dying in 1524. He taught medicine and philosophy at the university of Ferrara. He was well known for his scholarship and knowledge of Greek, indeed it was ^{for} his expertise in languages rather than for any purely medical skill that he was famous. An example of this is his commentary on the Hippocratic Aphorisms, which did not contain any innovation in medical knowledge but was an attempt to bring out more clearly the actual meaning of Hippocrates.

The interest of Leoniceno for my thesis lies in the fact that he was the first writer to distinguish order or procedure in knowledge from methods of dialectic and teaching. By order he meant the order by which the mind discovers knowledge and the procedure by which knowledge is put into practice.

Leoniceno's analysis of the difference between order and method meant that method was reduced to a mechanical tool for proof or for teaching, while it was order which expressed the natural working of the human mind and hand when creating knowledge and techné. The subordination of method to order had important repercussions, for whereas the Paduan natural philosophers might consider the dialectical method of resolution a means of discovering knowledge, the medical writers following Leoniceno considered dialectical resolution a sterile and mechanical means of filling in detail. It was from the Platonic and Aristotelean tradition of the end or purpose of an art that Leoniceno drew his definition of the order in which the mind created knowledge. The order which started from the phenomena - the order of Paduan resolution - was not that of knowledge but of praxis.

Leoniceno's commentary on the opening of the Ars Parva was essentially a learned and scholarly paper. There are various editions of the work. In the Opuscula of 1632, the commentary was entitled:- Nicolai Leonicensi Vicentini de Tribus Doctrinis Ordinatis Secundum Galeni Sententiam. The structure of the treatise illustrates the painstaking and scholarly nature of Leoniceno's research. He first of all stated the problem and pointed out the two opposing schools of thought. Then he went back to the old authorities and examined their writings, and by a careful consideration of both the Platonic/Aristotelean tradition of method and of the text of the Ars Parva, Leoniceno was able to show

that both schools were wrong and to supply his own solution.

I shall give quite long sections of paraphrase and translation from Leoniceno's work. This will not only give a flavour of the commentary but also supply its content, for Leoniceno has the great merit of being reasonably self-explanatory - as he felt that he would have to convert his readers from their entrenched opinions.

At the beginning of his treatise, Leoniceno gave an outline of the issues that he would examine. He wrote that, among the questions raised in the Ars Parva, those concerning the three orders of teaching ('de tribus doctrinis ordinatis') which Galen described in the proemium produce difficulty. This was especially so of those two which were called resolute and compositive, for concerning the third which was called definitive there was no difference amongst the Latin commentators on Galen.

Some commentators asserted that resolution is demonstration accordingly or 'because of that' (esse demonstrationem quam ob rem sive propter quid) and composition is demonstration 'so that it is' or 'why it is' (demonstrationem ut sit sive quia sit). Other commentators differed and stated that the resolute doctrine proceeds from the posterior to the prior and composition demonstrates the posterior from the prior. The author of the first assertion was Drusianus, named Plusquam Commentator. Petrus Aponensis, named Conciliator, was the author of the second opinion. (31)

Leoniceno then wrote that as there was so much discord

amongst the authorities it would be necessary to explain first what the ancient philosophers meant concerning the major doctrines, how many there were and of what kind, before Galen's meaning concerning these doctrines was sought. (32)

The 'ancient philosophers' that Leonicensio considered were not only Plato and Aristotle but also their commentators. The opinions of Ammonius, Simplicius, Joannes Damascenus or Grammaticus, Alcinous, Proclus and Alexander of Aphrodisias were ~~discussed~~ *discussed* by Leonicensio. Omitting most of Leonicensio's work on the ancients I will simply consider his description of the work of Ammonius.

This shows how Leonicensio tried to bring out what the ancients meant by the four teaching ways ('modi doctrinales') and the four methods of dialectic ('quatuor sunt methodi dialectices'). Later, Leonicensio contrasted the 'modi doctrinales' and the 'methodi dialectices' with Galen's three teaching orders ('de tribus doctrinis ordinatis') and showed that the 'modi doctrinales' did not parallel the 'ordo doctrinae'.

Leonicensio wrote that Ammonius, "the most learned philosopher among the Greeks writes thus about the four doctrines in these words in the preface to his exposition of the book of Porphyry on the five voices." Leonicensio then gave Ammonius's opinions:-

"There are four teaching methods, the divisive, the definitive, the demonstrative and the resolute. Now they are called teaching because each person who teaches something uses one of them; for example, if I were about to show that animal is a genus, I

use the divisive and say: Because we say that a genus is that which is divided into many species such as a man, goat and ox, therefore animal is a genus. Now if I want to show the nature of man, I use the definitive. For I say as follows: Man is a rational animal, capable of understanding and learning. Then, if I wish to show why it is that man is an animal I use the demonstrative and reason thus: Man is rational, the animal is always rational, therefore every man is animal. If, however, I wish to show that man is composite, I use resolution and say: Man is composed of soul and body, body is a whole, every whole is composed of some parts, therefore a body is immediately composed of organic parts; now the organic parts are the head, the feet and the rest . . ." (33)

Having given Ammonius's description of the four teaching ways, Leonicensio went on to give Ammonius's opinions on the four methods of dialectic:-

"The same Ammonius writes as follows in his commentaries on the Prior Analytics of Aristotle: 'There are four methods of dialectic which are certain faculties and as it were offshoots of the same, the divisive, definitive, demonstrative and resolute, and the resolute is opposed to the three former methods. Now, let us run through each individually, so that we may learn how much it is opposed to them. The divisive divides one into many. The definitive, by collecting into one the many which are in one thing separates that thing from others and distinguishes it. The demonstrative shows that one thing is in another. The resolute goes back from composites to simple things, and no-one doubts that the resolute is opposed to the divisive. For the latter divides one into many but the resolute draws many together into one.

It is likewise opposed to the definitive. For the definitive out of many elements which are in something (for example the genera and differences), makes a single composite definition, whereas the resolute resolves a composite into its basic elements ('simplicia'), for it considers both the classes and the differences of which it is constituted.

It is also opposed to the demonstrative, for this joins one thing to another, for example it shows syllogistically by a composed syllogism that immortality exists in the soul. The resolute, however separates the same.

So it may be said, to sum up: the divisive separates genera into species, but the resolutive combines species into genera, the definitive re-constitutes a whole out of parts; the resolutive, however, passes from the whole to the parts of which the whole is composed. Again, the demonstrative shows the things caused from their causes; the resolutive, on the other hand, advances from the things caused to the cause; therefore the resolutive is opposed to all." (34)

This passage from Ammonius presented Leoniceno with many possibilities. It showed that there was no real difference between the four ways of teaching and the four methods of dialectic - that, indeed, they were the same. So therefore, the term 'method' applied both to teaching and dialectic and had the same sub-divisions in both cases. This meant that it was easier for Leoniceno to state that Galen did not mean method or way but order of teaching. For Leoniceno could contrast the four divisions of method in both dialectic and teaching with Galen's three orders of teaching.

The point made by Ammonius that resolution was opposed to division, definition and demonstration also helped Leoniceno. This gave authoritative reasons against the opinion of Plusquam Commentator which identified resolution with demonstration.

However, the major constructive innovation which Leoniceno introduced, once he had discussed the identification of the three types of order with dialectic, lay in the way that he brought out the difference between order and method. In the central passage of his commentary, Leoniceno showed that the point at issue was not the difference between dialectic and teaching, since both could be subsumed under 'method' or way.

The real difference was between order and method, and so that he could explain this Leonicensian drew upon the Socratic/Aristotelean tradition of the final cause and of the end of an art:-

"The fact that the three doctrines set out are not teaching methods may be gathered by an argument of this kind.

The ordinary doctrines or orders of doctrines according to Galen are only three. However, the methods of teaching ('modi doctrinales') according to the ancient philosophers, are more than three, at least four. Therefore the 'modi doctrinales' are not the 'doctrinae ordinatae' of which Galen speaks.

Now the fact that the orders under which each science can be taught are only three is proved as follows: either the science which is taught is taught in the same order in which it is found and first established in the mind, and this order of teaching is called the resolatory; or it is taught in the opposite order, and this order is called the compository.

As if someone wishing to teach the art of building a house should first teach the form and material of which the roof should be constructed, second, how the walls are to be erected, third that foundations should be made and last how the earth should be dug out. He would be observing the resolatory order of teaching which begins from the conception of the end. For covering and defence from cold and rain is the end which a man who wants to build a house establishes for himself." (My italics) (35)

The numerical argument that Leonicensian used may appear somewhat pedantic or scholastic, though, if the binding force that tradition held for Leonicensian is taken into account, numerical contradiction between two sources would be a powerful argument. The interesting point lies, however, in Leonicensian's proof that there are only three orders.

In this proof Leoniceno described the resolutive order. The a priori nature of the resolutive order was made very clear; for it was an order of teaching a science corresponding to the order by which the science 'is found and first established in the mind.' Leoniceno has equated here orderly teaching with the order of discovery.

The rather naive example of the reverse order of teaching the building of a house by starting with the roof and ending by digging the foundations gains force by the directness of the exaggeration. Leoniceno is saying that the resolutive order does not start a posteriori or with the order of the actual building, but rather it "begins with the conception of the end." The final cause of a house is covering and defence, and so the idea of a roof is discovered as a means of fulfilling this purpose and the resolutive order in teaching the art follows this sequence.

By describing the resolutive order in this way, Leoniceno directly opposed it to the dialectical method of resolution which started from the particulars or phenomena of the world and ascended to universal causes. This was to be of crucial importance for, as we shall see, Montanus was to make the method of resolution subordinate to the resolutive order. I have shown that this subordination was probably implicit in the Phaedrus which stressed the priority and importance of knowing the end of an art. It is definitely implicit in Leoniceno, for by joining the order of discovery and the order of teaching Leoniceno made explicit his conception

of the sequence of discovery. This sequence with its a priori beginning was the direct opposite of that employed by the Paduan Aristotelians as described by Randall.

When Leoniceno described the compository order, the difference between discovering and actually putting the discovery into practice was clearly brought out:-

"But if he observes the contrary order and first teaches how the earth is to be dug out, second how the foundations are to be made, third how the walls are to be raised and last the form and material in which the roof is to be made, an order of this kind would be called the compository, which corresponds with the order in which a house is made, just as the first resolatory order is the same as the order in which the rationale of building a house is discovered" (sicut primus resolutorius est idem cum ordine quo ratio faciendae domus invenitur). (My italics) (36)

The third order was that of definition and Leoniceno wrote briefly of this:-

"But if someone defines the science which he intends to teach and in his teaching follows the order of definition of the parts, he is practicing definitive teaching, which Galen in the preface of his Ars Parva promises that he will do." (37)

Later in the treatise Leoniceno discussed how the order of definition was to be discovered. Essentially he followed the passage from the Phaedrus and joined the order of definition with that of division. He wrote:-

"But Plato praises and admires this same method of division so that, in the dialogue which is called the 'Phaedrus' he says, in the person of Socrates, that he looks from behind at the footprints of the man who has correctly carried out the art of dividing, as if they were a god's it is as much more worthy than the demonstrative doctrine as the knowledge of principles is more worthy than that of conclusions; how much more excellent also is that doctrine which explains the essence of a thing than that which shows that there are accidents in some substance." (38)

Leoniceno's preference for principles in contrast to conclusions and for the essence of a thing rather than its accidents is part of a view of the world in which the permanence of cerebral knowledge was more important than knowledge per se of the transient nature of the world. It may appear paradoxical that the tradition which stressed a priori knowledge should originate in the discussions of the nature of the practical arts as opposed to that of the theoretical sciences. Yet it is understandable, for in no other type of subject can both 'praxis' and 'theoria' be contained together; and as Aristotle stated; in the work of Nature 'theoria' is perfectly fulfilled by 'praxis'. The strength of the argument from a final cause is simply that Nature or man creates or builds something that was not previously in existence. As man obviously does not build without an idea of what he is going to do, so the existence of the final cause must appear plain and, indeed, necessary.

Leoniceno also praised the definitive doctrine for he saw it giving certainty in life:-

"If that ability [of defining] were useless, the act of knowing [something] would become a nullity, yet the philosopher supposed that this, [knowledge], was the final end of man and so human life would be spent labouring for what is uncertain." (39)

However, Leoniceno wrote that division was necessary for finding out definitions, and that division was the basis for the other doctrines:-

"For if a divisive doctrine is not a true doctrine, neither will a definitive be one, and if a definitive is not one neither will a demonstrative . . . But division is necessary for the discovery of definition." (40)

In the Phaedrus, definition and division are used to give substance to an art and to fill in its appropriate categories. When Leonicenso wrote that he who "follows the order of definition of the parts . . . is practising definitive teaching" he meant that the parts of an art are first divided and then defined, and this^{is} essentially the same process which was described in the Phaedrus.

However Leonicenso did not consider that the statement of the purpose of an art was a definition. He established this point by making a correction in the commentary of Plusquam Commentator.

"For the first exposition of Plusquam Commentator on those words of Galen "Three is the whole number of the doctrines that have order. The first from an idea of an end which is made through resolution ('Prima ex notione finis quae per resolutionem fit'). is altogether contrary to Greek grammar, according to which the relative 'Quam' cannot refer to the idea of an end but only to the doctrine (i.e. 'Prima!'). And also as it had previously been declared on the authority of Simplicius and of Galen himself that the idea of an end does not come from resolution but precedes resolution. Galen says in the aforesaid introduction that no-one before him had written a doctrine beginning from the idea of an end from which all arts are established according to reason, as the old translation has it."
(My italics) (41)

Leonicenso repeatedly emphasised that resolution came after one had found out the end of an art. He had already established that knowing the purpose of what one was doing occurred first in the order of discovery. This meant that resolution or analysis was not viewed by him as a creative process but rather as a mechanical filling in of the content of an art, for if order came before method (i.e. before resolution) and

discovery was included in order, then method was barren of creative content.

The importance of what appears at first glance as a minor emendation of the views of previous commentators is hard to minimise for Leoniceno's humanistic scholarship had a very definite influence. Towards the end of his treatise Leoniceno discussed the question of whether Galen proceeded by the resolutive (a posteriori) method or by the compository (a priori) method. At the end of his review of the arguments about the issue Leoniceno returned to his distinction between order and method and to his belief in the need to know the end of an art before one used any method. Leoniceno stated that Galen in De Constitutione Artis Medicinalis wrote from the authority of the old philosophers that every art is established from the notion of its end and Galen understood the notion of the end not through a remote cause or final effect (resolution and composition) but the conceived purpose of an art was from the mind.⁽⁴²⁾

For Leoniceno resolution and composition were of secondary importance. In an earlier part of the treatise he wrote that he would repeat again and again that the notion of the end antecedes resolution ('ut etiam magis ac magis postea declarabimus notio finis antecedit resolutionem').⁽⁴³⁾ The reasons that Leoniceno gave for the precedence of the notion of the end of an art were, as we have seen, based upon textual criticism and his repeated reference to the authority of Simplicius and Galen over that of the medieval commentators.

There is really no sign of original thinking on the part of Leonicens. The expression of a point of view contrasting sharply with the method of resolution and its stress on particulars emerged, not in the fanfare of a Cartesian Discourse, but in the relative obscurity of a scholarly and somewhat pedantic article.

Yet this should not be very surprising for this was no shaking of the world picture. It was a return to the Greek idea of the power of the mind over the mere analysis and collection of knowledge. However, Leonicens's affirmation of this idea did not entail the creation by the mind of new knowledge in the way that Descartes was to do by his method of contemplation but rather it was an assertion of the way in which the old knowledge of the ancients had been created.

Nevertheless, the idea that the mind was superior to the resolution of particular instances whether experimental or logical had the effect of giving some justification for the preservation of old theories. For if truth was grasped once by the mind it should endure for ever and there was no need to question such a truth, whereas particulars grasped by the senses were always open to doubt. In the next chapter I shall show how writers after Leonicens brought out the implications of this view.

CHAPTER VII

METHOD AND THE STATIC NATURE OF KNOWLEDGE

In this chapter, I shall examine how the debate which Leonicensio re-opened on the Ars Parva was expanded by Montanus. In the writings of Montanus the problems of method, which were still rather inchoate after Leonicensio, were more clearly organised. At the same time Montanus put his conclusions about method into practice, for he used them as the format for his teaching.

I shall then describe the connection between Montanus and Sanctorius and make clear the debt that Sanctorius owed to the discussions on medical method that had gone on before him and to which he himself later added with his own commentary on the Ars Parva. In this way, the historical derivation of Sanctorius's ideas on method, which, as I stated in the chapter on Sanctorius, I had omitted there, should be complete.

The themes that emerge from my analysis of the ideas of Montanus are similar to those of the previous chapter. There is an emphasis on universals as opposed to particulars and it is through the mind and not by a series of particulars that universals are arrived at. The view that Montanus held of knowledge is reflected in his discussion of method, particularly in his explanation of the order of resolution and the method of resolution, and also in his discussion of the method of signs.

Another theme concerns the practical application by Montanus of his ideas on teaching methods. There is a strong echo of this in the method that Sanctorius used for writing the Methodi Vitandorum Errorum (1603), and it is possible to show that both Montanus and Sanctorius were indebted to the Ars Parva.

Finally, I hope to strengthen the analogy between my analysis of the work of the anatomists contained in the first part of my thesis and my description of views of knowledge in the second part by examining the commentary on the Ars Parva of Argenterius. The ideas of Argenterius are in sharp contrast to those of Leonicensio and Montanus; for Argenterius was able to see that the views of knowledge being propounded gave no creative role to experience and to the senses. In his commentary on the Ars Parva, Argenterius also showed that he understood what the anatomists had done with regard to the rete mirabile and the animal spirits. His analysis of the situation is incisive. The fact that he had a different view of knowledge from the one commonly held by medical writers, and that he was also able to reject a fundamental physiological theory, lends support to the possibility of drawing an analogy between the two parts of my thesis.

Montanus

Jean Baptiste da Monte or Montanus was born in Verona in 1498. He was educated at Padua and taught at Brescia,

Naples and Venice. He came back to Padua and was offered the chair of medicine in 1536 which he held until his death in 1551. Both Castiglioni ⁽¹⁾ and O'Malley ⁽²⁾ write that Montanus was the first to introduce bedside clinical teaching as part of the medical education at Padua. He did not publish anything, and it was only after his death that two books were issued from his lectures, the Opuscula Varia (1558) and the Medicina Universa (1587). There is little difference between these apart from some verbal changes; the Op^uscula has some contributions by other writers added to it and has, as Dr. Wightman writes, ⁽³⁾ the air of a commemorative volume. Montanus also gave lectures on the Ars Parva and these were published in 1554.

These brief facts give the impression of a practical rather than a theoretical man, a man who was more interested in teaching than publishing; perhaps as rare a phenomenon then as it is today. It is necessary to bear this impression in mind when reading the complex and tortuous argument on method that sometimes confronts us. It was not a love of disputation, but a need to arrive at the best method of teaching that forced Montanus into the murky waters of dialectics and orders of teaching.

The title used for the edition of his lectures, Medicina Universa, is probably a true reflection of the intention of Montanus's lecture course. The first part of the Medicina Universa was entitled Methodus Medicinae Universalis and Montanus began with the words:-

"I have decided to lay before your eyes all the fundamentals of medicine arrived at by division and resolution so that we can apply particulars to universals (in which is the perfection and end of art)." (4)

This statement epitomises the position of Montanus and, indeed, of Sanctorius when he wrote the Methodi Vitandorum. Montanus would state the fundamentals of medicine and then describe the particulars appropriate to those fundamental categories. The implication of Montanus's opening statement are that the particulars, symptoms or observable phenomena are denied any role in creating or forming the basic causal categories of medicine. I shall discuss this later and show how, in fact, the 'universal method of medicine' was only universal in relation to existing knowledge and did not take into account the possibility of discovering new fundamentals.

That Montanus actually used the title Methodus Medicinae Universalis is very probable. In his commentary on the Ars Parva, he said:-

". . . you ought also to note one other thing in our method presented last year [in methodo nostra data anno elapso], in which, concerning a single point, I retract - and sometimes it is not bad to turn back from an error, for until now I did not see what I have related this year. In fact, last year I said in that universal method [in methodo illa universali] that a certain composite was separate and distinct from the resolutive way, concerning which I retract." (5)

This statement tells us that Montanus thought of his previous year's lecture course as being about a universal method and it indicates that it is possible that the commentary on the Ars Parva was given after the lectures on method.

The manuscript from which the commentary on the Ars Parva was edited was certainly written after Montanus had given lectures on method; however it is probable that he gave his lecture courses on a recurrent basis so it is difficult to say which lectures were produced first. The influence of the Ars Parva is so great in the Medicina Universa that the two cannot really be separated.

The Medicina Universa is divided basically into the theory of teaching and the actual teaching itself. Apart from the section on the theory of method, there is a description of the method of signs and symptoms and chapters on the definition of medicine and on what is the proper subject of the art of medicine. After these theoretical discussions there follow chapters which have a greater relevance for the teaching of the substance of medicine. In these later chapters Montanus described the elements, the diverse temperaments of the members, the doctrine of the four humours and the nature of the faculties. These general divisions were made more specific with explanations of the hot and cold members of the body, the types of phlegm, the melancholic juice and black bile, the different kinds of faculties and so on. What Montanus, in fact, did, was to put into practice his intention of applying particulars to the fundamentals of medicine.

The connection of this with the method 'per syndromen signor^um' that Sanctorius used in the Methodi Vitandorum and which I described in chapter five is very apparent.

The work of Montanus is more general than that of Sanctorius; while Sanctorius dealt with curative medicine and applied particulars or signs to the categories of disease or of treatment, Montanus, on the other hand, laid down more general explanatory principles, not just those derived from curative medicine, but also the wider principles which described the nature of the human body. Despite this difference both men agree in applying particulars to pre-ordained fundamentals.

I do not intend to examine at length the later parts of the Medicina Universa, for they are simply descriptions of a Galenic-Aristotelian view of the body set out in terms of categories of causes and their particular instances. Rather, I want to discuss the way in which Montanus wrote about the nature of method and signs or symptoms.

The Methods of Dialectic

Dr. Wightman⁽⁶⁾ has written of the difficulties of the writing of Montanus. He explains how Montanus castigated those who confused order with method and he writes:- "After reading da Monte's eight folio pages . . . It would be inappropriate to attempt to follow even in outline the subtle analysis that da Monte finds necessary to resolve this confusion." I hope to make the attempt and trust that the confusion is not compounded.

Montanus wrote fifteen chapters on the method and order of teaching, his purpose being to justify his assertion that the fundamentals of medicine were arrived at by division and

resolution. This meant that in his discussion of dialectics he sought to show that division was the origin of the methods of dialectic and that resolution was a close offshoot of division. When Montanus came to the three orders of teaching - resolution, composition and definition - he again declared, like Leonicensis, that the order of resolution was the most important. From these fifteen chapters one can gain some valuable insights into the opinions of Montanus concerning medicine and the nature of medical knowledge. Montanus developed his argument at length, at times at too great a length; however, I will give an outline of his discussion as well as extracting the points that are more directly relevant for this thesis. To do otherwise would mean destroying the logical nature of what Montanus wrote.

The first two chapters ask "what is method", "what is the medical type of method" and the third states that "without method the medical art cannot be taught correctly by anyone."⁽⁷⁾ Chapters four to thirteen discuss the numbers and various types of method. The next two chapters deal with the three teaching orders of the Ars Parva. From there, Montanus went on to describe the categories of temperaments, the similar parts of the body and the methods appropriate for teaching these categories.

The first three chapters emphasise the importance of method as a means of gaining knowledge in science and art, and especially medicine. The description of method that Montanus gave was drawn from the commonplace renaissance

accounts. In the first chapter he called method, "a very brief way"⁽⁸⁾ and repeated a well-worn analogy:-

"It [method] is transferred also through a metaphor to the sciences and to the arts, when we imagine to ourselves the shortest route proper for reaching the end of an art." (9)

By stating that method allowed one to arrive at the purpose of an art, Montanus made it clear that he was concerned with the tradition stretching from the Phaedrus to Leonicensis which stressed the importance of knowing the end of a particular art, and being able to achieve that end with the help of method. If Montanus had written that method was concerned with ultimate causes, then he would have been closer to the Aristotelian philosophers of Padua who viewed method as a means of arriving at fundamental causal knowledge of the phenomena of the world.

Montanus, moreover, showed the close connection between the mind and one's capability in using method:-

". . . as Johannes Grammaticus [Philoponos] in the Proemium of the Physics defined method, it is nothing else except a habit of the reason towards some end. First he says, it is a habit as we say because it does not suffice to hear and learn method, but it is required that we have a habit which is some particular disposition fixed in the mind by many repeated acts or actions." (10)

The description of the action of the mind is similar to that which was to be given by Sanctorius. As I showed previously, Sanctorius wrote that many instances or sequences of particular events would help the mind to arrive at universal causes, although this would not happen in an inductive or mechanical way, but by the light of the mind. However, Montanus,

following Philoponos, is arguing that method itself is a fixed disposition or habit acquired by the mind without which it is not possible to arrive at the end of an art, however much we may know about the technicalities of method. As Montanus himself acknowledged this opinion was ultimately derived from Aristotle's Ethics. In that treatise Aristotle had discussed the dispositions of the mind which were necessary for anyone concerned with science, art or prudence, and Montanus wrote that method embraced both "necessary things as science and knowledge" and "contingent things as art and prudence."⁽¹¹⁾

Montanus then asserted that method was necessary in all aspects of medicine. In order to arrive at the end of medicine, which is health, one used resolution - that is the ailments of the body are to be analysed by resolution so that their causes may be known; when known they can be treated. One could also begin from the reverse direction and from the causes, by composition, arrive at the human body.⁽¹²⁾ Method is thus necessary whichever way one looks at medicine.

However, although he had stated that method was necessary for medicine, Montanus had to define the status of medicine so that he could then decide what was the appropriate method to use in medicine. Out of the possible categories of science, art and prudence Montanus chose art. This was because medicine dealt with contingent and not with necessary statements.⁽¹³⁾ Montanus wrote:-

"I conclude therefore that it is not possible to acquire medicine without that method. However, it has been declared that all arts are acquired through a single true reasoning. You have moreover Aristotle's authority in 7. Metaphysics and 6. Ethics, where he says that arts are acquired by reason and method and Aristotle teaches that the resolute method is used for gaining health which Galen [also] teaches. Besides you see that Galen [i.e. Plato] says in the Philebus that no art can be acquired without the method of division and resolution. For whoever [he says] thinks that he has mastered some art without method, let him be informed that he has the shadow of that art not the art itself." (14)

Montanus had written at the beginning of the Universal method of medicine that he would "lay before your eyes all the fundamentals of medicine discovered by division and resolution." In the space of three chapters, Montanus has arrived at the conclusion that medicine needs method, that it is an art concerned with contingent truths and that the classical authorities had approved of the use of division and resolution for an art. In the next few chapters, Montanus tried to show that the other methods of dialectic (demonstration, rhetoric, definition,) were not so applicable to medicine as division and resolution.

Montanus dismissed demonstration when he wrote that:-

". . . to know and to speculate is the end of sciences and they [the sciences] end at universals. Art and prudence, in fact, revolve around actions and particulars. That is why the way of demonstration is not suitable for them because demonstration is from the necessary and concludes with the necessary, it is needed most greatly therefore in the sciences." (15)

It is when Montanus analyses the nature of division and definition that his more general views about medical knowledge

became apparent. Up to this point Montanus can be seen to fit into the Plato-Leoniceno tradition which I described in the last chapter; for he considered medicine to be an art concerned with its end or purpose, and not a science concerned with the demonstration of causal statements. However, where precisely Montanus stands in this tradition only becomes clearer when he discusses the primacy of division and its relationship to definition and demonstration.

Montanus wrote that there were many types of division:-

"For we divide the continuous into proportional or quantitative parts, and this is division proper. The rest are transferred from this through a metaphor as Galen writes in the end of the book *De placitis Hippocratis et Galeni* [i.e. *Platonis*]. The first division is of the continuous in its proportional or quantitative parts. The second is of a genus into species as when animal is divided into its species. The third is of a word into its meaning, as when we apportion [senses of] the word 'dog' to the sky, sea and earth. Another is of the composite into its components, as when we divide the human body into heterogeneous and similar parts. The fourth division is into potentiality and act as when we divide a simple body into matter and form . . . The fifth when [we divide] a subject into its accidents as when we call some men white, others black. However, the artificial division which physicians use is of the whole into its formal parts."⁽¹⁶⁾

The reason why the division must be into formal parts was because, as Montanus pointed out, it is possible for the continuous or the multiple to be divided infinitely but as physicians deal with particular individuals it is necessary that the division end with determinate numerical parts or forms.⁽¹⁷⁾ Having decided to divide something into its formal parts Montanus then explained the path of division as follows:-

"Whence the progress starts from universal and descends to the less universal and again from the less universal into parts still less universal till it shall have come to particulars and finally to individuals, so it is not possible to divide any more. This is the division of Aristotle, from which all arts and sciences are constituted and medicine especially turns upon this art of dividing and it is what you ought to use in consultations for prognosis and for healing correctly." [My italics]⁽¹⁸⁾

The starting point of division is a universal; division does not enable man to create a universal, for the universal is already known. Division, which Montanus asserted was the origin of all dialectics, was thus seen as a purely mechanical instrument. It is true that one needed judgement or 'habitus' to use division correctly, but the essential function of division was to progress from universals to particulars and so to be able to apply universals to particulars. As this was Montanus's stated aim it is not surprising that he defined division in this way, but it meant that one must look elsewhere to find out how the mind arrives at universals.

Montanus wrote in praise of division as follows:-

"And so great therefore is its efficacy, that from correct division all arts and sciences emerge. For this reason Plato does not unjustly name it the ornament of philosophy and in Philebus he said that man did not invent division but some god. And if not a god, at least a man most like a god."⁽¹⁹⁾

The mention of Plato is significant, for Plato believed in the absolute divorce of universals from the phenomena, whilst for Aristotle the separation was less complete. The way in which Montanus described division meant that he was closer to Plato's way of thinking, as the universals were not discovered in any way from the phenomena, but rather the phenomena

were waiting to be categorised into their proper universals.

Montanus also emphasised his debt to the Plato-Leoniceno tradition by repeating Leoniceno's view, which I have mentioned previously, that division was necessary for definition and demonstration. Montanus stated, "I say that the usefulness of division is the greatest of all, since definition is arrived at from the divisive method." He continued, "Definition, however, is the middle-term in demonstration, therefore demonstration is not possible without being established by division."⁽²⁰⁾

The description that Montanus gave of definition reinforces my view that, for Montanus, the universals of knowledge are somehow given and already present. Definition was a way of proceeding from the highest to the lowest and vice-versa. Montanus wrote that when we wish to know the total essence of a substance, we start with the primary descriptions and aim towards the ultimate definition. In order to arrive at the ultimate definition of man we use division. First we state that there is substance from which everything is derived and then we divide the various attributes of substance, such as simplicity and multiplicity or corporeality and incorporeality. Then we divide the attributes of corporeal substances such as the possession of three dimensions. Simple bodies have to be divided from multiple bodies; for simple bodies are elements whilst multiple bodies have matter and form. This process of division continues until we arrive at species, "and through the way of division we come to the

ultimate definition which states 'man is an animal with rationality', and so you [the students] are in the ultimate species." (21)

The way in which Montanus explained the nature of division and definition carries the implication that categories such as 'potentiality', 'the continuous', 'species', 'elements', 'dimensions', 'form and matter' are all equally valid, as well as being already 'given'. Neither division nor any other method discovers these basic categories. Montanus did not show in his writing that he felt that there was any difference between the numerical divisions of proportionality, simplicity and multiplicity and the more physical divisions, ranging from corporality and incorporeality to the more specifically theoretical categories of potentiality, actuality, matter, form and elements. It is quite clear that Montanus accepted the basic Aristotelian theory of the physics of the world and he thought that to divide a substance into its numerical or into its elemental nature was equally valid. This implicit belief in the truth of fundamental or causal physical categories underlines, I feel, the fact that for Montanus, the dialectical method of division was not a means of discovering universal truths, but rather a way of arriving at a definition of an individual by correct division of the universals involved. It also shows that the static view of basic theoretical knowledge which, I am arguing, was an important part of the consciousness of medical writers, can be found in Montanus. That Montanus did hold such a static

view of knowledge is made more probable by what he wrote concerning the cognition of universals in his discussion of the method of signs which I shall consider later on.

At the end of his chapter on division, Montanus summed up the importance of division and asserted that all dialectic stemmed from division:-

"Moreover who resolves or composes without this method of dividing? For resolution and composition are extensions of division, indeed the total dialectic art and all the instruments fit for investigating truth originate from division
 . . . The use of division is greatest for all arts and sciences which centre around particulars. For whoever wants to deal with particulars it is necessary that he has division itself as an instrument." (22)

The sterile consequences of this elevation of division by Montanus for the relationship of method to knowledge should, I hope, now be clear.

Montanus went on to describe the two exten^sions of division - resolution and composition. There is no doubt that he felt that resolution was almost as important as division and for a physician it was more useful, Montanus praised resolution for its similarity with division:-

"Resolution is, however, a more beautiful doctrine [than definition] which is always next in precedence to division on account of the resemblance which they have. For both are concerned in the progress between universals and particulars and they run from universals to particulars and vice-versa." (23)

Resolution differed from division, however, in that division did not stop in its progress on reaching particulars; (24) in other words when we use division we do not consider the validity of the intermediate steps. Resolution did consider

intermediate steps and unlike division examined causal relationships. Montanus wrote:-

"Resolution starts from one compound particular and resolves it into its causes and takes them and searches as far as the cause of the cause and for the third time does the same and seeks their causes and again for the fourth and fifth time nor ever resting until the time it comes to [deveniat] the first cause, which when it has reached it [invenerit] stops and contemplates the thing which it invents [invenit]. Physicians and all artificers use it and it proceeds in this way." (25)

When one reads the example that Montanus gave of the working of resolution it becomes clear that for him the causes are already there, despite his use of the verb 'invenio'. The art of resolution lies in knowing that one has arrived at the correct causes rather than in discovering the causes themselves by resolution. The example that Montanus used confirms this impression and conveys the sense of his complete acceptance of orthodox medical theory. He wrote:-

"We wish to possess health? By all means. We resolve it into its principles. What in fact are the principles of health? Equality, for if that is present health is present. On the contrary, if there is illness, then there is inequality. We wish to remove the illness, the inequality should be removed. One takes the inequality afterwards and resolves it into its principles. But what are the causes of inequality? A departure from an [equable] temperament through heat, cold, wetness, dryness. And if one learns by a sign [symptom] that it is through cold or excess in temperature through cold, then it [the equable temperament] is brought back through heat." (26)

Montanus then asserted that we had to know by how much the illness departed from the normal in coldness and to do this we have to know what the normal degree of cold is and then to find out the excess of cold. Montanus took the quantity

two as representing a greater degree of cold than the normal; and in order to treat this we would have to use medicines which heat beyond the normal by a factor of two and for this we would rub down the patient, as rubbing heats by the requisite factor of two. (27)

At the end of his example Montanus summed up the relation of treatment to the concept of health as produced by resolution:-

"Lo and behold! how the last in discourse is now the first in action. For through rubbings it [the body] is brought back to the [correct] temperament and the temperament leads it to health. However, health which was first in resolution is last in execution. On the other hand, rubbing, last in resolution, is first in execution." (28)

It is quite clear from this that Montanus considered resolution to be the proper method of relating a particular instance or case to a system of explanatory categories. The sign of the disease is crucial, for the sign, in this case too much cold, enables us to have a knowledge of the cause of the illness and once we know the cause the cure becomes apparent. However, the sign only indicates what particular cause is involved - it does not help a physician to discover a completely new cause of illness.

The idea that illness occurs when there is an inequality in the temperament was not derived from resolution nor was the doctrine of the cure by opposite qualities. Montanus stated that health was a 'compound particular' and he meant by this that health was made up of various causes. In the example that Montanus used cold is just one of the specific

causes that make up the equality of temperaments which in turn produces health. That, in fact, cold is the cause of the illness is made known by the signs evident in the patient when he is examined. The 'progress' of resolution enables one to understand the causal relationships between health and equality of temperament and cold and heat; however these relationships are not discovered by resolution but rather they are laid out for the student so that he can see the connections between them.

The difference between division or definition and resolution I think confirms this interpretation. When a man is defined by division, universal concepts such as 'animal' and 'reason' are used to provide the unique statement 'man is an animal with reason' - the definition being both universal and applicable to no entity other than man. The definition of health when it is arrived at by resolution is neither unique nor universal; for the causes of health are various, and as Montanus stated later the forms of health are also various. Therefore, the resolution of a compound particular such as health will lay open several possible causes for health; which particular cause is actually involved in producing a given illness can only be known when the appropriate sign or symptom is seen by the doctor. Again, the description that Montanus gave of resolution was influenced by his desire to apply particulars to universals. The effect is also the same, knowledge of causes is already given, the art of medicine lies in being able to relate the condition of the patient to this fundamental knowledge.

The last dialectic method that Montanus described was the second extension of division, composition. Montanus did not write at great length about it. He explained how the progress of composition was the reverse of resolution:-

"For this starts from the most simple just as resolution started from a compound particular and it proceeds thus:- you will cure a man if you warm him, because you lead him back to health, that is, to the equality in which is health." (29)

Montanus then stated that the method of composition was not as perfect as resolution:-

"That way [composition] does not teach first principles; it is methodically true [true by method] but imperfect, because he who resolves knows how to compose. Whoever, in fact, composes does not [necessarily] know how to resolve. That method is more appropriate for younger people who are not suited for the resolute method." (30)

Composition means that one starts with the principles arrived at by resolution. If a cause of bad health is an excess of cold which can be rectified by heat then a medical student is taught that he can immediately treat the patient by composing back this cause of ill health and arriving at the single composite particular - health - from which the cause was originally resolved. There is therefore practically no need for the 'habitus' or disposition of using method correctly for this has been done previously during the course of resolution.

In the twelfth and thirteenth chapters Montanus summed up his arguments about the methods of dial^octic. Essentially his conclusion was that medicine had to join universals 'which were stored in the mind' to particulars. The only

two methods that were able to do this were division, which "reaches from universals to particulars", and resolution which "starts from a particular and resolves it up to the first principles."⁽³¹⁾ I have already pointed out the implications of these two methods for Montanus's conception of knowledge. However, how basic knowledge is initially discovered becomes slightly clearer when Montanus discusses the three orders of teaching and more so when he explains his 'method^d of signs'.

The three orders of teaching

Montanus was plainly indebted to Leonⁱcen^o's commentary on the Ars Parva when he wrote on the "three orders of teaching" (de tribus ordinibus doctrinae) in the three chapters that follow his discussion of the methods of dialectic.

Montanus began:-

"Now there should be discussed the actual order of teaching. Galen therefore in the opening of the Ars Parva says, 'Three are the orders of teaching', which passage vexed and racked doctors themselves for a long time. For they cannot imagine how those ways [i.e. methods] are regulated by those orders, nor do they realise that doctrine, or way of doctrine, differs from order." (32)

Having stated the problem in a manner reminiscent of Leonⁱcen^o, Montanus went on to give his solution which I must admit is not as clear as it might be:-

"They differ, I say by that difference by which subject differs from passion, and order flowed from the essence of doctrine just as passion [flowed] from the essence of subject; nor is it possible to conceive in the imagination teaching without the order by which it is to be learned from the art . . . It is however order [with doctrine],

their connections and consequences, which lead to action, so that one depends upon another from the beginning up to the end, and therefore order is not separate from doctrine. But, in fact, doctrine differs from order just as passion does from subject. The orders however, which are inherent in doctrine cannot be either more nor less than three . . ." (33)

What Montanus is trying to say is that order regulates and gives shape to teaching and to the methods of teaching (division, definition, etc.) We would therefore expect that the orders of teaching would be more important and prior to the methods of teaching, and this, in fact, is the case.

The most important order in the opinion of Montanus was that of resolution. The influence of Galen's Ars Parva and Leoniceno's commentary is very apparent when Montanus tried to distinguish between the order and the method of resolution. He made several attempts at this with varying success. However, the fact that he did try to spell out the difference is in itself interesting; for it shows his awareness that the order of resolution starting from the end of an art with its implications of final causes and echoes of the Phaedrus was different from the method of resolution with its rather mechanical and analytically sterile undertones.

Montanus gave a brief initial description of the order of resolution:-

"Another order starts from composites and resolves them into causes and into their principles and so observes the order of resolution, which no one besides Galen used, that is why he boasts himself when he says, "Only I have used the resoluteive

order" and in lib. de constit artis, he uses such an order. For he starts from the notion of the end, that is from the object of the art and resolves it into principles and causes until he reaches the first. Which order we ourselves propound, imitating Galen in the order but not in the subject matter. Nor do we proceed by another path than [by the one] with which Galen advances." (34)

In the chapter following his brief discussion of the order of resolution Montanus claimed that the resolutive order rather than the compository or definitive orders should be used in medicine. The chapter was entitled: "The method of all medicine is propounded through the order of resolution." This wide claim is repeated in the text of the chapter; Montanus began:-

"Now we place in front of your eyes all medicine so that all the fundamentals be observed with one glance, and because we wish to relate them by method, we cannot start elsewhere than from what Galen declared in 1. Method where he says that all method springs from the conception of the end." (35)

Up to this point the explanation that Montanus gave of the order of resolution is reasonably straightforward. An order of teaching gives direction to the methods of dialectic, it produces the starting point for method and points to the way which the method should take. Thus the order of resolution starts from the notion of the end of medicine, which is health and the method of division, for instance, can analyse the term health. However, the situation is not so simple. I have described how Leoniceno quoted the ancient commentators to show that the order of resolution which began from the notion of the end gave a description of the order

of discovery. Thus we have a conception of the purpose of a house, that of protection and shelter and we then imagine the roof, and the walls until we reach the foundations. The order of resolution tells us what is needed, in the case of medicine this is health, and it also describes how we set about achieving our aim. The problem is that there appears to be little difference between the order and the method of resolution if the order of resolution not only gives direction to method but also analysis^s concepts such as health. Montanus was aware of this difficulty and his attempts to explain the difference between the two gives one further insight into his idea about knowledge. Montanus asked:-

"But someone may say, 'what is it to start from such a notion of the end? The resolute method takes some subject and resolves it into its principles. But now may we see how, having made resolution from the notion of the end, we establish the art?' Medicine is an art whose end is health. It is for the sake of health that the physicians learn and practice the art [of medicine]. Therefore health is the object. If we want to create the art, one should conceive of that end not, I say, the name itself, but its nature." (36)

Montanus followed Leoniceno's opinion that resolution came after the notion of the end. Therefore what the order of resolution does is to analyse the end of an art once it has been discovered by the mind. As I will show later the method of resolution analyses the individual terms of what has been found out by the order of resolution. Thus the mind first finds out the purpose of an art, the order of resolution then analyses that purpose, and the results of that analysis^s give to the four methods the subject matter -

for division, definition, demonstration or resolution.

The way that we conceive or imagine (*concipimus*) the end of medicine as opposed to asserting it by reason, involves the conception of a universal. Montanus explained how the end of medicine could be conceived:-

"We perceive, however, its purpose by virtue of a universal conception, [understanding] that it is something good, because when men possess it, they are healthy and they are active. When they are ill and lacking that end [i.e. health] they cannot be active. If it is something good, at once the proposition is engendered in us, that we will pursue that good. And so there are two [notions] here: one is the cognition of the intended goal [or object], which is health. The other proposition relating to health is the desire to practise well and pursue health rightly, when it is absent, or to maintain it if it be present. This is the proposition of the physician, from which arises directly the method discovered from its object, because the object stimulates the action because of the concept of "good". Therefore the desire for health arises from the concept of "good": to preserve it when it is present, to restore it when it is absent. We conceive the conception in general ['in universali'] and by this manner begin the first steps towards healing and the art [of medicine], as Galen says in *de sectis ad Thrasybullus* and in *de artis constitutione medicae*." (37)

Montanus did not think that there was any mechanism or logical method for grasping the purpose of medicine. By reason we can assert that the end of medicine is health, but it is only when our understanding has conceived that the end of medicine is part of the universal conception of goodness that we can truly know that health is the purpose of medicine. The desire of the physician to practise medicine arises out of his realisation that what he seeks to achieve is part of the good. The manner in which Montanus explained how the mind grasps

the purpose of medicine is definitely reminiscent of Plato, and Montanus agreed with Leonicensio in asserting that the very basis of medicine is not derived from the phenomena but is realised by the mind. Again, the fundamental framework of the art is produced by the mind without reference to the outside world.

The order of resolution is then used to expose the principles of health so that we can achieve health. Montanus wrote:-

"We wish to induce health, since it is a good but we cannot do this unless we know the principles by which health is established. Therefore these ought first to be known. Men conceive the universal and common conception about health to be that sort of natural form appropriate to the human body. If health is the form appropriate to the human body from which arise [its] natural activities, it must be founded on some [state of] equality. For every natural form and every natural power, appropriate to the subject in which it resides, is founded on some [state of] equality, for nature makes the instruments and the subjects which operate [them] appropriate to the complexion and form for the active agents and everything that operates according to its own temperament operates according to a [state of] equality. If, in fact, it has been equal it will work correctly, if unequal wrongly. Since, therefore health is of such a form, of necessity it follows that it depends on equality." (38)

What Montanus meant is clear enough even if his logic leaves something to be desired. The crux of the argument is that health is a form natural to the body and for any such form to function properly it must have the property of equality, as health is such a form it therefore depends on equality. What is interesting is that Montanus used the idea of health as a form, and the Platonic ^mimplications of this become more obvious when he continued:-

"Therefore if there were one [form of] equality in the human body, there will be only one [form of] health, nor will one have to seek for more [forms of] health. If, in fact, there are many equalities there will be as many [forms of] health and [arising] from the inequalities, illnesses." (39)

Montanus has here argued that there is a one to one relation of forms of equalities with types of health. In fact, Montanus believed that there were three equalities in the body: the mixtures or temperament of the four primary qualities, the composition of the similar parts and, thirdly, the composition of the dissimilar parts which are made from similar parts.⁽⁴⁰⁾ Now the point to note is that when Montanus rationalised his assertion that health depended on equality he developed the argument a priori and did not attempt to bring phenomenological evidence to show that the body depends on equality. The order of resolution arrives at the three forms of equality and then the dialectic methods can be used on those forms. Thus the order of resolution, which is prior to the four methods, is an order which describes the progress of the working of the mind - as Leonicensio had also stated. The subordination of the four methods to the orders meant that the working of the mind created knowledge and is superior to logic, which is left to chew over mechanically the matter provided for it by the mind. In the commentary on the Ars Parva Montanus made more explicit the difference between order and method.

The difference between order and method

The lectures that Montanus gave on Galen's Ars Parva were published in a posthumous edition in 1554 under the title In Artem Parvam Galeni Explanationes. This commentary, like the one that was to be written by Sanctorius, is of no great intrinsic interest. The influence of the Ars Parva on both men seems to have been diffused into their more general works. Their commentaries are pedantic and take the scholarly method of Leonicensio too far, especially so in the case of Sanctorius.

The debt that Montanus owed to Leonicensio can be seen plainly in the Methodus medicinae universalis; however in his commentary the need for scholarly exactitude and disputation seems more important for Montanus than the development of original and constructive thought. Despite this there are two passages where Montanus attempted to explain the critical difference between order and method. The first attempt is rather confusing⁽⁴¹⁾ and Montanus came back and tried again:-

" . . . I laid down the difference between the resolute way or method and the resolute order, this resolute way being one simple progress [advance] taking what is complex and resolving it into its principles. However, the resolute order has a certain great similarity with the resolute way: for just as the way starts from the notion of the end and dissolves it into its principles, so also does the resolute order, but they differ elsewhere. They differ in this, that the resolute way is not multiple but simple and directs itself towards a particular goal in knowledge; but order is multiple and directs itself to no particular goal in knowledge, but rather to universal [objects]. So that

when anyone declares the purpose in the medical art, which end is health - and it is a universal end - then he divides into its principles by dividing into matter and form. And many resolutions and also many divisions and many definitions and many demonstrations are made in the parts and all the divisions". (My italics) (42)

From this passage it is possible to understand what Montanus meant by the difference between the order and the method of resolution. The order of resolution proposes a universal statement, in the example given this is the universal end of medicine, health. The four ways or methods of dialectic - division, definition, demonstration and resolution then analyse the principles contained in the universal statement. Therefore, the four methods, of which the way of resolution is one, are applied after the universal end of an art has been found by the order of resolution.

The subordination of method to order is confirmed by this explanation of the difference between order and method. How universals were understood by Montanus is the next question that should be asked; for knowing what Montanus wrote about universals will allow one to say whether the impression given so far by Montanus about knowledge is correct.

The conception of universals

After Montanus had discussed method, order and the three types of equalities in the body in the Medicina Universa he went on to consider how the particular phenomena with which medicine was concerned could be related to the universal causes constituting health. Montanus had stated that medicine

deals with particulars and throughout the Medicina Universa he stressed the need of the doctor to apply particulars to universals. Montanus explained how particulars could be known and he wrote that the four methods could not make particulars apparent to the mind:-

"And since there are only four teaching methods, we conclude that by none can we know individuals. By what art therefore? [can we know an individual] Individual things are known through accidents and through the sense because the sense takes to itself particular objects . . ." (43)

Montanus went on to state that we view the actions and operations [i.e. the signs] of individual men as singular when we consider some as natural and some as animal [intellectual] actions, and from these particulars we decide on the appropriate universals [ex illis particularibus universalia iudicamus] (44)

Montanus then concluded from this:-

"And at this point we begin to show, obscurely how universals are applied to particulars. And around this order the medical art turns proceeding by means of signs, with which we deal at length afterwards." (45)

The separation of universals from the phenomena is very apparent in this preliminary outline of the relationship of particulars to universals.

In the Methodus Universalis Signorum, which is part of the Medicina Universa, Montanus explained how the method of signs should be used. The doctrine of signs had been an important part of the Ars Parva and I have discussed Sanctorius's writing of the Methodi Vitandorum 'per syndromen

signorum' that is by the application of particulars to given universal causes or categories. The explanation which Montanus gave of his method of signs is important for understanding the thinking of Sanctorius and for showing close similarities in the work of both men. Moreover, the 'Universal Method of Signs' gives added force to my thesis; for in his explanation of signs Montanus made it clear that he was erecting a barrier between particular phenomena or signs and their universal causes. Universals were produced by the mind, they were not derived from the observations of particulars by the senses.

In the chapter 'On the power and nature of Signs',⁽⁴⁶⁾ Montanus discussed the difference between signs and causes and by what means the mind could judge that a particular sign could be explained by a particular cause. In the process of doing this Montanus defined the difference between causes and signs:-

"And thus we have taught, so that we have now found its causes [those of health] through the way of resolution; but since we are concerned with particulars and on that account we are called sensitive artificers, we ought to discover the causes of diseases; but we cannot do this [discover them] in particulars because we are made aware of particulars by the senses, which do not make causes known to us; for causes are universals and are to be perceived only by the mind: consequently causes are hidden from the senses". (47)

It would be difficult to make a more definite assertion of the separation of causes from the particular phenomena of the world. Montanus went on to describe the process whereby the mind recognises that a cause explains a particular sign.

He wrote that a sensory impression could be conceptualised by the mind and, by some means which he does not clearly describe, the hidden causes or universals which are appropriate to the sign are then evoked from the depths of mind. Montanus gives us a hint of how this is accomplished when he states that an analogy is made between the particular and its cause. Presumably he meant that faced with a new sense impression the mind processes it and recognises in it those elements of it which correspond to the universal causes with which it is already familiar. The cryptic lecture notes of Montanus merely state, however that:-

" . . . we ought to proceed to the recognition of causes by way of a sign evident and apparent to the senses. And when that effect is perceived, since it is a particular sign and perceptible to the sense it arouses the sense then is carried back to the intellect and forms a concept in it. Then [the intellect] refers [the sign] to the hidden causes [i.e. universals], and draws an analogy, which is a certain relation [of the nature] of the particular to [that of] the universal." (48)

Montanus developed this description and wrote that when a particular sense impression is placed before the intellect "it joins itself to the causes recognised already by the intellect", and from recognition that a particular depends upon a specific cause knowledge emerges. (49) It is nearly impossible to understand what Montanus really meant because he is describing the kinematics and not the dynamics of a psychological process and there is little insight into the causative factors involved. Nevertheless, what Montanus has said here bears some resemblance to his description of how

the mind recognises that health is part of the concept of goodness. Only in this case Montanus is describing the interaction between sensory perception and explanatory causes. The particular, by intruding upon the individual mind, joins its proper universal or cause. This universal has already been recognised by the intellect, that is, the innate idea has been brought to the surface and articulated by the intellect. The particular or sign is recognised as belonging to that class of particulars that is explained by the cause in question, and from a recollection that the sign belongs to a certain cause knowledge emerges. The whole emphasis of the argument is against induction or the derivation of knowledge from a series of particulars. The causes are already in the intellect, and as Sanctorius was to write, not a hundred thousand particulars could produce a universal. The only function of the perception of particulars is for it to act as a trigger whereby the mind is excited into producing the correct cause of the perception.

The example that Montanus gave of this was the somewhat trite one of no smoke without fire:-

"For example; you know the nature of fire and you recognise in it this property, that it sends out smoke. Fire is hidden in some place, you know fire, it is true, but not that it exists there, however smoke comes out and when this is perceived by the sense you know that fire is present there. Thus the signs make an appearance to the sense [the signs become apparent to the sense] and so they are understood (interpreted) by the sense. For through this interpretation you know [in the case of medicine] thus that attribute of which that is the characteristic sign." (50)

The smoke does not give knowledge of fire but rather prior knowledge of the nature of fire gives understanding of the nature of smoke. In the same way the diagnostic role of the sign of a disease will enable a doctor to diagnose the correct disease. However, as in the case of fire and smoke, the nature of a disease is not derived from the signs of the disease, but our prior knowledge of the disease enables us to make sense of the signs. The Platonic tone of the description that Montanus gave of the method of signs and of the relationship of universals to particulars is very apparent.

Summary of the views of Montanus

It should now be clear that Montanus developed his ideas on method within the Plato-Leoniceno tradition that I have described, and in fact extended that tradition. Montanus emphasised the importance of division in dialectic and made it the origin of all the dialectic ways. Leoniceno had done the same, but Montanus argued the case more clearly and at greater length. Likewise Montanus fully developed Leoniceno's belief that the order of teaching was prior to the method of teaching. By stating that the four ways were subordinate to the order of resolution Montanus made it clear that he subscribed to the Platonic-Galenic view of method and not to the Aristotelianism of the Paduan philosophers who might have considered the methods of dialectic

as the primary instruments of discovery. In fact, from the description of the order of resolution and of the method of signs it is very apparent that the mind of itself brings to the surface the innate universals which are in it.

In essence, therefore, one is left with an impression of knowledge heavy with Platonic overtones. The theoretical discussions which Montanus developed of method, order and signs enabled him to apply particulars to universals and to teach Aristotelian and Galenic biology and medicine within the universals particulars scheme. The resemblance with the method 'per syndromen signorem' of Sanctorius in the Methodi Vitandorum is very strong and the views of Montanus and Sanctorius concerning knowledge are very similar; for both subscribed to the opinion that universal causes are found in the mind and exist prior to the perception of phenomena. Thus the theme of my thesis that there was a conception of basic knowledge which was a priori and not derived from the phenomena can be seen to extend from Plato to Sanctorius via the mediation of such men as Galen, Leonicensis and Montanus.

The commentary on the Ars Parva by Sanctorius

The connection between Sanctorius and Montanus is made even stronger, in a formal sense, by the fact that Sanctorius also wrote a commentary on the Ars Parva. This was entitled Commentaria, In Artem Medicinalem Galeni, Libri Tres and was published in 1632.

Unfortunately, from the point of view of tidy derivation, the commentary of Sanctorius on the Ars Parva has the same characteristics as the commentary that Montanus wrote. Sanctorius continued in the scholastic and rather pedantic manner of Montanus. As in the case of Montanus the influence of the Ars Parva can best be seen in the other writings of Sanctorius, and the exigencies of scholarship seem to have prevented the development of original ideas in the commentary itself.

At the time when Sanctorius published his commentary on the Ars Parva the debate between the Aristotelians and the Galenists was in full flow and the disputatious nature of Sanctorius's writing is increased because of it. An instance of Sanctorius bringing the Aristotelian-Galenic debate into the open is when he posed the question:- "If the definitive order or doctrine is different from the compositive and the resoluteive."⁽⁵¹⁾ Sanctorius wrote:-

"Almost all the Peripatetics are seen to resist Galen in this matter; for they say that in no way can the definitive doctrine be distinguished from the resoluteive, nor that other orders, or inherent doctrines for order, are allowable other than the order of resolution and composition. Thus we review their basic ideas, in fact we reject them for the defence of Galen and we shall confirm the doctrine of Galen."⁽⁵²⁾

Sanctorius went on to give four basic reasons that the Aristotelians used in support of their opinion and then to deal with each in turn. His conclusion was that definition was, in fact, a separate and very important doctrine.⁽⁵³⁾ This is not very surprising for I have described in the

chapter on Sanctorius his praise of aphoristic and definitive knowledge. However, the idea of his general support for definitive knowledge gets lost in the argumentative verbiage which he used for proving the Aristotelians wrong.

The impression of losing sight of the wood for the trees is a very strong one. In one or two places, nevertheless, one can see how themes that Sanctorius developed elsewhere arise from, or are present in, his interpretation of the Ars Parva. In the Methodi Vitandorum Sanctorius had argued that a universal could not be derived from a series of particular instances. In his interpretation of the text of the Ars Parva Sanctorius considered the discussion of definition in which Galen had asserted that not all the particular instances possible in medicine could be described as they were infinite. Sanctorius wrote:-

"Doubt arises, as to why Galen has written that medicine is not of particulars for it is seen that the physician is concerned with particulars . . .

"It is replied that the doctor in no way treats or cures particulars as such. . ." (54)

Sanctorius cited various passages in Galen which stated that: "the expulsion of diseases is indicated by a specific condition; therefore what is cured is specific and not singular." (55)

Sanctorius went on to write that a study of a particular condition does not of itself enable the doctor to cure it, but reference must be made to universals; if in fact a cure was effected, and this was solely derived from the particular,

then medicine would be laughable - Sanctorius was probably thinking of the empirics in this context. He wrote:-

"Moreover, if medicine cures singular cases, [only] as they are singular cases, then vain is the art. . . because art and all intellectual dispositions are universal and not particular, as Aristotle teaches . . . because nothing is contained in particulars . . . if particulars are cured, their indications do not show us the remedies because the progress from particular to particular is not allowable; therefore the medical art is altogether vain and ridiculous." (56)
[because the cure would be by chance]

Sanctorius also looked at the possibility of arriving at a cure by induction:-

"Furthermore, if induction, which proceeds by many particulars does not conclude with a universal conclusion except in the third figure - which way of concluding is shown by Aristotle as most vain - how much the more [vain] if particulars are cured [of] themselves." (57)

Sanctorius wrote that neither by induction of particulars nor from a single particular can we make the connection between the indications that a particular case gives to the doctor and the cure itself. Sanctorius concluded by summing up the difference between universals and particulars:-

"Therefore they [particulars] are most vain indications and conclude nothing. Hence Galen 9. Methodi cap.6 says, in universals is the method of healing, in particulars, in fact, only the method of practice. We gather therefore that medicine is centred around universals and not particulars." (58)

This statement corresponds very closely to what Sanctorius wrote in the Methodi Vitandorum. Sanctorius in his commentary on the Ars Parva did not disagree in any fundamental way with the views of Leonicens and Montanus. The description that I gave earlier of the rest of his work becomes more

understandable when viewed in terms of the Ars Parva debate. The distinction between universal causes and particulars, the impossibility of induction, the idea that fundamental knowledge is static and not in question whilst the phenomena can be doubted - these are all part of the Plato-Ars Parva-Montanus tradition, as I have shown from the basis of Sanctorius's thinking. However, this sense of coherence and agreement ceases when we examine the commentary on the Ars Parva written by Argenterius.

Argenterius and the Ars Parva

Johannes Argenterius was born in 1513 at Castel-Nuovo in Piedmont. He studied in Turin, went to Lyons, and at the end of 1544 was offered the public chair of medicine at Pisa. Afterwards he migrated to Naples, Rome and Mondovi and finally settled in Turin until his death in 1572.

Argenterius was something of a *bête-noir* for the Italian medical establishment. He attacked Galen and the over-dependence on logic of the medical writers. Although an Aristotelian, Argenterius felt that one should not rely solely on authority and believed that observation of the nature and course of a disease could give a new insight of the causes of the disease. A belief in Aristotle and in independent observation should not have been mutually exclusive, for Aristotle himself stressed the importance of observing phenomena for gaining basic knowledge, in contrast to Plato. Nevertheless, a sixteenth century Aristotelian was unlikely

to believe that his own observations could overthrow the teachings of the Philosopher, and to that extent Argenterius was closer to the mood of the seventeenth than of the sixteenth century.

Argenterius published the In Artem Medicinalem Galeni Commentarii Tres in 1553. It is full of his anti-Galenic feeling. Of the forty citations of Galen in the Index, eight are about Galen's life, one notes Galen's opinion on regeneration of the parts and the other thirty-one are all adverse. Two examples will convey the tone of Argenterius's hostility:-

"Galen does not carry out the method proposed by himself"

"Galen is to be damned, because he says that the amplitude of the thorax follows the heat of the heart" (59)

The criticism that Argenterius made of the Ars Parva and its commentators serves to underline the essential issue that I feel stems from the Ars Parva. What concerned Argenterius was that the methods discussed in the Ars Parva and developed by the commentators were not satisfactory for reaching true knowledge.

Argenterius began his criticism by stating, "that the instruments of teaching are more than four." In his list of possible instruments he mentioned the four methods and the three orders but he included also intellect, the demonstrative, dialectic and sophistical syllogisms, induction, example, and, heading the list, 'sense'.⁽⁶⁰⁾ Argenterius

needed more instruments because he felt that the method of the Ars Parva did not deal with the real nature of universals and their particulars, and he wrote:-

"For it is not sufficient to set out names, to define [and] to divide things and to explicate their properties but, it is often proper to teach their causes and effects, which this method does not teach [literally - towards this, this method does not teach - Ad haec non docet haec methodus.]" (61)

The complaint of Argenterius was that the methods and orders of the Galenists could not teach us anything concerning the nature of universals or enable us to consider the validity of universal causes and their effects. In fact, Argenterius stated that Galen's method was only fit to teach singular things. (62) In a sense he was quite right.

Leoniceno and Montanus both believed that the mind of its own light arrived at universals. Therefore, although method would begin from universals, the nature of the universals itself was not considered by method or order. The crucial point is that neither Leoniceno nor Montanus would have wanted method to be used in the production of universals; for their theory of the creation of universals precluded the mechanical or inductively logical conception of basic knowledge.

Argenterius was correct in asserting that the Galenic method could be instructive only in relation to singulars; for what the order and method of resolution do is to set out the way in which particulars are related to given universals. The fact that Montanus hoped to be able to apply particulars to universals and that Sanctorius was to develop

his method 'per syndromen signorum' by using order and method indicates that the function of the methods being used was to bring out the relationship between singulars and universals in such a way that one could have some certainty that a particular was part of a certain universal.

Argenterius realised that static and barren nature of such an approach; for it meant that the fundamental knowledge handed down by antiquity would go unquestioned - the only problem being to make the authorities agree with each other:-

" . . . for in the proving of things we observe not what reason and our senses (given us by Nature in order that we may understand things) teach, but what Aristotle, Galen and, what is worse, anyone at all has written about that matter. We collect their sentences and stitch together our books [with them] and we publish with a thoughtlessness that ought to be cursed, we labour beyond measure in reconciling authors, which no-one even of the most outstanding writers has ever been able to do. And as long as we live by the opinions of others, we show ourselves not to be men but beasts." (63)

The reaction of Argenterius was almost that of a seventeenth century man; for then a lack of independent thinking was recognised as being caused by too great a reliance upon the ancients. Argenterius did not put his teachings into practice, however, except in one or two places, and it is a fortunate coincidence for my thesis that one such occasion was his attack on the theory of animal spirits.

In his commentary on the Ars Parva, Argenterius used reason and sense when he discussed the formation of animal spirits by the rete mirabile. He denied that there were

three types of spirit and asserted that there was only one, which performed all the functions of the three Galenic spirits. His argument shows how his realisation that basic theoretical knowledge could be questioned enabled him to take the evidence of the anatomists to its logical conclusion and to deny the existence of animal spirits.

I shall paraphrase the argument. Argenterius asserted that Galen had not shown that there were three types of spirit; for Galen himself doubted the existence of natural spirits, and as for vital spirits, he had stated that no-one had demonstrated them to be evident. However, the animal spirits were demonstrated to the senses. Argenterius then wrote that the place from which the animal spirits arose had been thought to be the retiform plexus (the rete mirabile). This was not present in man, however, or at least it was certainly not so evident as in animals, but as men claim a purer spirit than animals they would need a more evident and skillfully contrived plexus.⁽⁶⁴⁾ This was the first reason that Argenterius gave for denying the existence of the animal spirits and it is clear that he took the anatomical evidence to its logical conclusion - logical that is if one was a believer in induction. For believers in the separation of universals from particular phenomena all it meant was that some other structure would be observed instead so that the universal could be visibly validated. This, as I have in fact shown, is what happened.

Argenterius also asked why if net-like structures are

necessary for the generation of spirits, there are no such nets in the heart where the vital spirits were generated.⁽⁶⁵⁾ Thus, by throwing doubt on one part of a theory, he tried to extend his attack to other parts of the theory.

Argenterius produced two further reasons for thinking that the animal spirits did not exist. Both reasons are derived from the conflict of opinion concerning the material from which the spirits were made and the place in which they were manufactured. Argenterius wrote that the usual opinion about the animal spirits is shown to be false because it is said that they are made now from vital spirits, now from the inspired air, now from the blood, and it is said that they are of the substance of fire. The belief in animal spirits is also false, continued Argenterius, because it is not possible to assign a place where the spirits are made; for sometimes they are made in the plexus, sometimes in the ventricles of the brain, now in the two front ones, now in the middle, now in the posterior ventricle, now in the veins which belong to the ventricles.⁽⁶⁶⁾

One can see that Argenterius understood what the anatomists had done. I have shown how they postulated different anatomical structures to perform the function of the rete mirabile so that the animal spirits could be preserved. Realising this, Argenterius was able to point to the diversity of the anatomists's shoring up operations as a reason for believing that the animal spirits did not exist. All this is consistent with his belief in the need to question

by reason and sense the basic theories of the ancients instead of trying to preserve them.

Argenterius's approach to the questions about method is analogous to his way of dealing with the relationship between observation and theory. It would not be true to say that it was only methodological reasoning which motivated Argenterius's rejection of Galen's animal spirits; for his alternative theory of one spirit drew heavily upon his Aristotelian beliefs.⁽⁶⁷⁾ Nevertheless, I think that the fact that he did reject the view of knowledge contained in the Plato-Montanus tradition and that he was also able to reject a fundamental explanatory theory in physiology in favour of the evidence of his senses, is relevant for the validity of my thesis. I have been arguing that the view of knowledge developed by men like Montanus is analogous to my interpretation of the status of knowledge as found in the work of the anatomists. One would therefore expect that if a medical writer rejected the philosophical ideas about knowledge of the Ars Parva tradition, he would reject also the manner in which the anatomists implicitly viewed knowledge. This, in fact, was the case with Argenterius,

However, the analogy can be made even stronger. Sanctorius wrote his commentary on the Ars Parva some eighty years after Argenterius. In it he discussed the status of anatomy, writing that, "the total skill of medicine rests in the perfect knowledge of anatomy." Sanctorius went on to state that Vesalius and other anatomists wrote much

against Galen. The reason that Galen was not versed in human anatomy was because, as he himself wrote, in the whole of his life he only examined two human cadavers and both of them were imperfect. Sanctorius then gave a list of some of the anatomical errors which Galen had made, such as the statement that the right kidney was higher than the left, this was, he noted, correct in animals but Galen had tried to apply his animal observations to men. (68)

What Sanctorius wrote about Galen's errors was drawn from the orthodox opinion of the medical establishment. In his discussion of Galen's mistakes in anatomy, Sanctorius did not go on to say that if the anatomy was wrong, then the functional explanations of the false observations might be invalid.

In his commentary on the Ars Parva, Sanctorius had occasion to deal with the criticisms of Argenterius. He wrote that Argenterius could not understand the secrets of Galen and that he had fallen into six hundred errors. (69) When he came to the opinion of Argenterius that the animal spirits did not exist the impression of Sanctorius's orthodoxy and his desire to preserve the theories of the ancients is confirmed.

Sanctorius stated that, "the animal spirit differs in nature from the vital, which Argenterius did not recognise." (70) Sanctorius gave some of Argenterius's reasoning and tried to answer it. The reasons that he gave against Argenterius are revealing. Firstly Sanctorius denied the anatomical

facts. He wrote that Argenterius had not seen for himself the anatomy of the human brain for in it the retiform plexus is conspicuous. Secondly, he argued that Argenterius was unreliable because he held that the opinion of Galen was that the animal spirit was made in the retiform plexus. Sanctorius replied that Galen never dreamt such a thing and that he only meant the plexus to supply and to prepare the material for the generation of animal spirit so that the animal spirits could then be made in the ventricles. From this description of Galen's theory Sanctorius was able to assert that it did not matter that the vital spirits which were made in the heart were not generated in a plexus, as he himself did not hold that the food of the spirits was only prepared in a plexus of vessels. (71)

Up to this point Sanctorius shows himself blind to the anatomical facts and tries to cut the ground from his opponent's feet by altering the terms of the theory in question - that is by stating that Galen did not believe that animal spirits were generated in the rete mirabile. However, in the next few sentences the almost comic nature of Sanctorius's defence of Galen becomes apparent. He gave the various opinions concerning the place where, in fact, the vital spirits were generated:- Galen supposed that blood was made in the right ventricle of the heart and the spirits in the left, Columbus that they are prepared in the lung, Botalus in the duct which runs from the right to the left auricle of ^{the} heart and Ulmus says that in the plexus of the splenic arteries

is prepared matter for the generation of spirits. (72) Until Sanctorius reached Ulmus he was just giving a list of the opinions of the anatomists as to where the vital spirits were made, but when he got to Ulmus he noticed that Ulmus had postulated a plexus for the vital spirits and from this Sanctorius felt able to conclude:-

"Lo and behold that at least from the teachings of Ulmus a plexus is given for the generation of the vital spirits, and therefore the argument of Argenterius is forsaken by all men." (73)

This probably expresses better than anything else the sterility of Sanctorius's thinking. He has used an opinion which was developed by Ulmus against Galen's idea of the function of the spleen, as a means of refuting Argenterius, little realising that the diversity of opinion was one of the points which Argenterius had used against the theory of animal spirits. For Sanctorius, opinion once stated assumes a validity of its own, whilst for Argenterius opinion had to be tested before it can be accepted.

One would, from my interpretation of Sanctorius, have expected him to react in this way to an attack on a basic physiological theory. The analogy which I drew from Argenterius also holds for Sanctorius but in the reverse sense; for Sanctorius believed in the view of knowledge which separated universals from particulars, and he also believed that anatomical observations could not radically alter fundamental theories. Again, the connection between the two parts of my thesis is strengthened.

CHAPTER VIIIJUSTIFICATION OF THE STUDY OF ANATOMY

In this, the final chapter of my thesis I shall depart from the style and subject matter of the previous chapters. In both parts of the thesis I have used purely medically-orientated material to develop my themes. The analysis of this material has concentrated on the close texture of its meaning whilst it has at the same time, I hope, allowed the broader interpretations of the thesis to emerge. It is necessary, I feel, to sketch here some disparate elements so that the conclusions of the two parts of the thesis may gain depth. In the first part, I showed that in some cases physiological theories did not radically change despite advances in observational anatomy. In the second part, I explained how a specific philosophical standpoint had been developed which appeared to be analogous to the situation current in anatomy and physiology. There are certain other facets of the history of medicine in the period from Vesalius to Harvey which, although not specifically related to the two parts of the thesis, illustrate and confirm my interpretation of the static nature of medical science in this period.

I shall here describe some of the traditional justifications for the existence and practice of anatomy which the medical writers gave to the general public in their prefaces.

In the course of so doing I shall explain in what way these comments give us hints about the nature of anatomy and physiology.

I shall also discuss briefly how the changes in the amount of space devoted to anatomy and physiology give us an insight into the state of medicine. These changes mirror the progress by which physiology, from being a static and traditional branch of medicine, became progressive in the same way that anatomy had been in the sixteenth century after Vesalius.

The change in the status of physiology will form a theme in this chapter. Hitherto I have tried to show that the fundamental explanatory theories of medicine and biology were not called in question by the medical establishment. However, I have described how in the period from about 1580 to 1610 various alternative theories drawn from the ancient authorities were being discussed, the antagonists usually thinking of themselves as Galenists or Aristotelians. The unsettling of the settled order of the basic explanations of man's body could produce in a staunch Galenist like Andreas Laurentius the feeling that the whole fabric of medicine was being threatened.

I shall use the introductory First Book of Laurentius's Historia Anatomia^c (1595) as the main source for my discussion of the introductions to anatomy; and then illustrate the increasing importance of physiology toward the end of the sixteenth century by considering the form of anatomy text-books.

Finally I shall set out two opposing points of view which emerge after Laurentius: on the one hand there is the pessimistic feeling that the decline and end of the world are at hand, held by those who believe in the previously settled picture of the world and of man; and on the other there is the optimistic view held by men like Daniel Sennert who, no great thinkers themselves, believe that enquiry into fundamental causes is possible and that new theories can be produced. With the victory of this optimistic belief the static view of knowledge was broken and my thesis ends.

The Prefaces of the Anatomical Text Books

The anatomists of the sixteenth century had an opportunity to discuss the usefulness and need for anatomy when they wrote the introductions or prefaces of their text books. Most of them gave essentially medical reasons: for the study of anatomy is useful for treatment, for surgery and for physiological or theoretical knowledge of the body. However, many anatomists, given a chance of digressing, tried to justify the usefulness of anatomy on more general grounds which would appeal to the ordinary non-medical reader. These introductions assume the form of tradition and many writers seem to repeat, almost verbatim, parts of this tradition. Andreas Laurentius appears to express this tradition most fully and I have used his introduction as my main example,

The chief, non-medical reason, for practising anatomy given by medical writers was that anatomy helped to give an understanding which went beyond the mere knowledge of the parts of man's body, for in the microcosm of man one could find knowledge of the greater world and also arrive at inferential understanding of the soul, since the body was the house of the soul and the soul expressed itself through the instrumentality of the body. Sometimes anatomies were called 'Historia anatomica', that is the anatomical story or history of the body. 'Historia' in this context has the dual sense of investigation or compilation as in the more modern 'natural history', and that of the medieval idea of history. In their introductions the anatomists often echoed the medieval concept of history. The medieval chronicles and histories frequently described events in such a manner that they became instructive stories usually in the moral sense. However, the story of the body is not a fable but something, which, if truly expressed, can illustrate the nature of the world and its phenomena, and also give us knowledge of the metaphysical principles of the soul.

The historical analogy can be drawn even further back. The 'likely story' of the Timaeus and the type of explanation given there of man's body may be viewed as a possible influence on the microcosm-macrocosm analogy which the anatomists made. I shall develop this point later.

My main intention in describing the introductions of the anatomists is to see what light they throw on the more

general conceptions which existed concerning physiology and anatomy. In the writings of Andreas Laurentius one can clearly understand the nature of these ideas.

Andreas Laurentius

The life of Laurentius and its conservative nature has already been described in chapter three. I have again drawn upon Helkiah Crooke's translation of the Historia Anatomica contained in his Μικροσκοποιαν. Crooke himself was a Galenist and it is not surprising that he should translate and use the introductory first book of the Historia Anatomica to express his general views on anatomy.

The first book of the Historia Anatomica was entitled:-
 "Liber Primus In Quo Hominis Dignitas, Anatomes Praestantia, Utilitas, Necessitas, et Universalia Anatomicae Artis Praecepta Explicantur."⁽¹⁾ Crooke's opening book is a translation of this first book of the Historia Anatomica and he described it as comprising "Of the Excellence of Man Together with the Profit, Necessitie, Antiquitie and Method of Anatomy."⁽²⁾ Laurentius wrote it as a greatly expanded version of the introductions written by anatomists.

In the first chapter of the book Laurentius stated that the subject of anatomy was man and he therefore gave the opinions of previous writers on man. All of them praised man. Trismegistus called man "a great miracle, a creature like the creator, the ambassador of the Gods". Pythagoras declared man to be "the measure of all things." Plato " Θαυμα

Θαυμασιώτατος, the wonder of wonders." Theophrastus "the patterne of the whole universe. Aristotle a politicke creature framed for society." (3)

Laurentius continued:-

". . . These are excellent, that I may not say divine commendations which man hath, partly from his soul, the most excellent of all forms, partly from his body which is as it were the measure and exemplary pattern of all things." (4)

Of the two parts of man, his soul and body, the soul is quickly dismissed as being too difficult to investigate directly and Laurentius stated:-

"Let us content ourselves to handle what may be handled or at least is subject unto some of our senses, and so proceede to the other part of man, namely, the bodie, which more truely and properlie is the subject of our discourse." (5)

As we shall see, Laurentius did think that one could acquire knowledge of the soul, but as the soul could not be perceived directly, our understanding could only be derived by examining the house and instrument of the soul, that is, the body.

After Laurentius had cited the previous praises of man, he developed the idea that man was 'the pattern of all things' in such a way that not only was man seen as the most perfect of all the works of God in a moral sense (i.e. by possession of a rational soul) but also as physically perfect, so that by investigating man's body a scientist had 'the best conditions for finding out the physical principles of other, less perfect, phenomena. For in man, there was a perfect 'crasis' or mixture of the qualities, and man

included in himself the principles of all things in the most perfect arrangement. Laurentius wrote:-

"As the soul of man is of all sublunary forms the most noble, so his body, the house of the soul doth so farre excell, as it may well be called $\mu\epsilon\tau\rho\omega\rho$ the measure and rule of all other bodies. There be many things which set foorth the excellency of it, but these especially among others. The frame and composition which is upright and mounting toward heaven, the moderate temper, the equal and just proportion of the parts; and, lastly their wonderful consent and mutual concord so long as they are in subiection to the law and rule of Nature; for so long in them we may behold the lively image of this whole universe." (6)

From this very simple account of the reason why man is the image of the universe, Laurentius went on to explain in greater detail the nature of the comparison between man and the universe. His explanation is derived essentially from elements of Aristotelian thought, though Aristotle himself might not have arrived at the same general comparison between man and universe; as the principles governing the universe were more important for Aristotle than those to be found in man.

Laurentius expressed the comparison almost in a tone of exaltation:-

"This is the Meteorology of this Little worlde, this is the demonstration of those things therein that are imperfectly mixed. And if you require an example of a bodye perfectly mixed, behold and consider the whole body; in which, there is that concord and agreement of the foure disagreeing qualities, and so just and equal a mixture of the elements as that it is the very middle and meane amongst all living and animated things. This Little World therefore, which we call Man, is a great miracle, and his frame and composition is more to be admired and wondered at, then the workmanship of the whole Universe.

For it is a farre easier thing to depaint out many things in a large and spacious Table, such as is the world; then to comprehend all things in one so little and narrow, as is the compass of man's body." (7)

The concept of the perfect workmanship of Nature can be found in Aristotle and Galen. The idea that in man is a perfect balance of the qualities and elements was part of Galen's explanation of the constitution of a healthy body and we have seen how Montanus repeated the idea.⁽⁸⁾ However the image of the body as the "Little World" corresponding to the greater world is not derived from Aristotle and Galen, but is, I think, partly drawn from the Platonic and Neoplatonic tradition.

In the Timaeus the body was described as partaking of both the spirit of the Demiurge and the material from which he shaped the universe. Therefore the body contained both the spiritual and material nature of the cosmos. Plato, in his 'likely story' described the creation of the universe first and that of the body last, but the correspondence between the two is such that one could say that by examining the body we should find contained in it the principles of the greater world.

Laurentius mentioned not only Plato but also Trismegistus as having praised man. Thus he says that man is a great miracle and this description of man is found in the Hermetic writings. In the Asclepius the divine love speaks through the lips of Hermes:-

"And so, O Asclepius, man is a magnum miraculum, a being worthy of reverence and honour. For he goes into the nature of a god as though he himself were a god . . .

Man is united to the gods by what he has of the divine, his intellect; all other creatures are bound to him by the celestial plan and he attaches them to himself by knots of love. This union of gods with men is not for all men but only for those who have the faculty of intellection. Thus alone among creatures, man is double, one part like God, the other formed of the elements." (9)

In the Hermetic writings, as in the Timaeus, the world is also a god. The vivifying breath of God is present in the world as in man. In Hermes Trismegistus to Tat on the Common Intellect we read:-

"The world too, is a god, image of a greater god. United to him and conserving the order and will of the Father, it is the totality of life." (10)

Again in The mind to Hermes the world is seen as alive and not to be understood as a mixture of elements or qualities:-

"And all this great body of the world is soul, full of intellect and of God, who fills it within and without and vivifies the All.

"Contemplate through me (that is through the mens) the world, and consider its beauty. See the hierarchy of the seven heavens and their order. See that all things are full of light. See the earth, settled in the midst of the All, the great nurse who nourishes all terrestrial creatures. All is full of soul, and all beings are in movement. Who has created these things? The One God, for God is One. You see that the world is always one, the sun, one, the moon, one, the divine activity, one; God too, is One. And since all is living, and life is also one, God is certainly One." (11)

The idea of the unity between the world and man and the exaltation of man expressed by Laurentius could well owe something to the Platonic and Neoplatonic tradition. Laurentius

was certainly conscious of this element not only by his reference to Trismegistus but by citing the 'wise priests of Egypt' and their belief in the three-fold nature of the universe:-

" . . . but this last exceedeth all admiration, that in itself alone, it should containe all whatsoever this whole world in his large and spacious bosome doth comprehend; so as it may worthily be called a Little world, and the patterne and epitome of the whole universe. The ancient Magitians (for so the naturall Philosophers were of olde tearmed) as also the great wise Priests of the Egyptians did make of this whole universe, three parts." (12)

The Hermetic writings were believed in Laurentius's age to have been written in Mosaic times and the reference to the Egyptian priests was a reference to the Hermetic writers.

There is, nevertheless, a fundamental difference between Laurentius and the Platonists. Laurentius did not say that we should contemplate man and so arrive at an understanding of the world in the Platonic sense. For Plato and Trismegistus the world and man were united in that they possess the living breath and principle of God. However, the principles by which Laurentius understood man and the world to be ordered were not Platonic or Neoplatonic but Aristotelian and Galenic. The unity of man and the world was not that of spirit but of elements and qualities. Thus, the conclusions that Laurentius would expect a scientist to reach about the world when he studied man would be confirmatory of Aristotle and Galen and not of Plato and Trismegistus.

This was made clearer when Laurentius described some of the details of the comparison between man and the world.

Earlier, he had stated that the principles that constitute the world are seen in their perfect state in the body of man. He went on to say that in man are to be found not only the principles but the various material phenomena of the universe:-

"Seeing then that Man is a Little World and contains in himself the seeds of all those things which are contained in the most spacious and ample bosom of this whole Universe, starres, meteors, metals, minerals, vegetables, animals and spirits whosoever doth well know himself, knoweth all things, seeing in himself, he hath the resemblances and representations of all things." (13) [My italics]

Laurentius then gave a list of reasons why man, by knowing himself, could know all things. Man would know God because he was the image of God. He would know Angels "because he has understanding as they have;" brute beasts, because he "has senses and appetite common with them;" man grows like plants; he has being and existence like stones - "and in a word, he is the rule and square of all bodies." (14)

The way by which we can gain this knowledge of our body is by anatomy. Anatomy also gives us knowledge of the other part of man, his soul. Laurentius added:-

"But this same knowledge of man's selfe, as it is a very glorious thing, so also it is very hard and difficult. And yet by the dissection of the body and by Anatomy, we shall very easily attaine unto this knowledge. For seeing the soule of man being cast into this prison of the body cannot discharge her offices and functions without a corporeall Organ or instrument of the body; whosoever will attaine unto the knowledge of the soule, it is necessairie that he should know the frame and composition of the body." (15)

Laurentius made here very great claims both for anatomy and for man. Anatomy will open up the physical and spiritual

nature of man and, as man is the perfect representation of the world, the principles that constitute the world can be derived from anatomy. I think that a result of these claims by Laurentius is that man cannot be explained by reference to other physical phenomena, but rather in man is to be found the explanation for all the varied and less perfect works of God. This means simply that reductionism cannot work here. (Reductionism I take to mean the explanation of man's body by reference to physical and chemical principles derivable from physical substances and phenomena simpler than man.)

However, a reverse reductionism was not implied by Laurentius either. He did not mean, as he might have done, that one could derive the principles of the world by finding out the principles of the body. Again, the theme present throughout my thesis becomes apparent in the writing of Laurentius. His view of knowledge is a static one which depended on the final cause and workmanship of God.

How man may be explained was hinted at by Laurentius in his chapter on "How profitable and helpful anatomy is to the knowledge of God":- (16)

"It is no doubt an excellent thing for a man to attain to the knowledge of himselfe, which thing Anatomy and dissection of bodies doth teach us . . . but there is another farre more Divine and usefull profit of Anatomy than the former proper and peculiar to us to whom the light of the Gospel hath shined, namely the knowledge of the immortal God. That high father and creator of all things, who onely by himself hath immortality . . . whom no man can either see with his eyes or comprehend with his mind; that eternall Father (I say) cannot

be known but by his effects; and all the knowledge of God that can be had, must be derived not a priori but a posteriori, not from any case or matter preceding but from the effects and things subsequent " (17)

Laurentius described the workmanship of God in making the various parts of the body and in producing a perfect accord between the parts so that each helped the others:-

"Consider the admirable structure of all the parts, Animall, Vitall and Naturall; wilt thou not cry out, though it be against they will, O admirable Architect, O unimitable workman! And wilt thou not with the inspired Prophet sing unto the Creator this Hymne, I praise thee (O Lord) because thou hast showed the greatnesse of thy wisdome in fashioning of my body?

Lastly the infinite goodnesse and bounty of God shineth in this excellent workmanship, inas-much as he hath so well provided for all the parts, that everyone hath her proper and peculiar use, and yet all are so fitted and knit together in such an harmonie and agreement, that every one is ready to help another . . ."

Laurentius then concluded:-

". . . these wonderfull and ever-worthy to be admired works of God in the composition and frame of man's bodie, are as it were dumbe School-maisters, the Books of vulgar divinity and the Doctors and teachers of divine wisdom." (18)

Laurentius has said here that there is a sense of wonder or admiration to be had in contemplating the final cause or workmanship of God in producing the human body and perfectly fitting the form of it to its various functions. He did not mean that we could deduce the universal principles by which God works (and which therefore express his nature) from the body de novo but rather that we can see the effects of those principles best illustrated by observing the human body.

That is why Laurentius wrote that "all the knowledge of God that can be had, must be derived not a priori but a posteriori, not from any cause or matter preceding but from the effects and things subsequent." To have said otherwise would have been heresy; by postulating a priori causes independent of God, in order to explain God or the creation of man, would have been to place oneself in the position of God and arrogantly to believe that man could think the thoughts of God.

This Christian attitude of not presuming to explain the creation of man and his body by principles which did not express and mirror man as the work of God was, I believe, very deeply held. The final cause was best fitted for explaining man as a work of God; for the idea that each part of the body was perfectly made to fulfil its destined purpose led to the conclusion that was desired - that God created man.

The initial antagonism of the Roman Catholic Church to the teachings of Descartes was partly due to his destruction of the final cause in explaining man's body. In contrast to Descartes, Sir Thomas Browne, who lived in the same age as Descartes, expressed in Religio Medici his belief in the final cause and its close association with religion. It was a belief already out of fashion but it is given fresh life by Browne's incomparable prose:-

"but every Essence, created or uncreated, hath its finall cause, and some positive end both of its Essence and operation; this is the cause I grope after in the workes of nature, on this hangs the providence of God; to raise so beauteous a structure, as the world and the creatures thereof, was but his Art; but their sundry and divided operations with their predestinated ends are from

the treasury of his wisdom. In the causes, nature and affections of the Eclipse of the Sunne and Moone, there is most excellent speculation; but to propound farther, and to contemplate a reason why his providence hath so disposed and ordered their motions in that vast circle, as to conjoyne and obscure each other, is a sweeter piece of reason, and a diviner point of Philosophy; therefore sometimes, and in some things there appears to mee as much divinity in Galen's Books 'De usu partium' as in Suarez Metaphysicks: had Aristotle beene as curious in the enquiry of this cause as he was of the other, hee had not left behinde him an imperfect piece of Philosophy, but an absolute tract of Divinity." (19)

The implication of this conjunction between the final cause and religion is that the specific causal explanations (elements, qualities etc.) produced by Aristotle and Galen could not be shaken. The physical principles which explained the working of the final cause were, for Laurentius, Aristotelian and Galenic. To throw doubt upon Aristotle's theory of qualities might, I feel, have meant for Laurentius and many like him, that the idea of the final cause, and therefore of God's creation of man, was being doubted. This was not consciously expressed by Laurentius but the close association between the Aristotelian-Galenic system and the final cause makes it feasible to admit of such a possibility.

Laurentius did discuss explicitly, however, the possibility of changing the principles which explained the physical constitution of the world. This he did when arguing about the position of Aristotle in relation to anatomy; as he was a Galenist, he would not be expected to be over-sympathetic to Aristotle's claims in the field of medicine. Laurentius wrote that Aristotle hid his meaning and so was understood

only by a few people and he compared him with the cuttle fish extruding ink to confuse its enemies. He continued:-

" . . . there are two parts of natural Philosophy; the first concerning the general and universal nature of things, the latter which searcheth out the particular nature of man and all living things. In the first Aristotle was so absolutely excellent as no man, no nor any age of men, may stand in competition with him, but in the second, how many things he knew not, how absurdly he understood divers things he knew, Galen and all the whole school of physicians have proved by demonstrations but especially by $\alpha\upsilon\tau\omicron\psi\iota\alpha$, or the sight of the eye, which is of all arguments the most demonstrative." (20)

Laurentius then gave the usual examples of Aristotle's failings that a Galenist would have given. Thus, he mentioned the fact that the heart is not the organ of sensation nor the origin of the nerves and veins as Aristotle had thought, and he derided Aristotle's theory that the function of the brain was to cool the heart. (21)

In his summing up of the achievements of Aristotle, Laurentius made precisely the same distinction between observation and fundamental theory that I have tried to bring out in this thesis. As Laurentius wrote, it appeared to him that Aristotle had done all the work that was possible in finding out the universal explanatory causes and categories of the physical world - and these principles were not now in question. In issues involving perception, however, Aristotle was as fallible as the next man and Galen and the physicians were able to correct him with true observations.

Remembering that Laurentius was a Galenist, then one might expect that the position of someone who was less of a professed follower of Galen would be similar to that of

Laurentius in respect of universal principles but in regard to the observation of the human body he would consider Galen as fallible as Aristotle. This, I feel, does describe the position of Vesalius. (22)

Laurentius indeed hinted at something like this in his appreciation of Vesalius, where he commented that Vesalius "wrote very accurately" but "having transcribed almost all his work out of Galen yet he cannot afford him scarce a good word, but either pricked by ambition, or with an itching desire to contradict so great an author he never leaves goading or wounding his reputation." (23) One could take the remark about the accuracy of Vesalius to mean that Vesalius corrected Galen's observational mistakes, and the comment about transcribing almost all his work out of Galen to mean that Vesalius accepted nearly all of Galen's functional theories - though this might be too charitable and not what Laurentius intended to express.

The idea that observational anatomy was something which still needed to be satisfactorily completed whilst functional or theoretical views were not in question is reinforced when Laurentius described the two-fold nature of anatomy. He called the first type practical anatomy, and the second he described as contemplative anatomy. The former, he says, is done with the hand, the latter with the mind:-

"Now there is amongst physicians, a double acceptation of Anatomy; either it signifieth the action which is done with the hande; or the habite of the minde, that is, the most perfect action of the intellect. (Nam aut actionem denotat, quae manu perficitur, aut habitum animi et actionem intellectus perfectissimam)." (24)

There is no link here between the anatomy of the hand and the mind; in other words, observational anatomy does not lead to a knowledge of the functions and causes of the phenomena being observed. Laurentius explained how the two types of anatomy can be learned:-

"The first is called practical Anatomy, the latter Theoretical or contemplative: the first is gained by experience, the second by reason and discourse: the first wee attaine onely by Section and Inspection, the second by the living voice of a Teacher, or by their learned writings . . . the first is altogether necessary for the practice of anatomy, the second is only profitable; but yet this profit is oftentimes more beneficiall than the use itself of Anatomy: the first looketh into the structure of the partes, the second into the causes of structure, and the actions and uses therefrom proceeding." (25)

Laurentius had two opinions about contemplative anatomy: the first related to its teaching, the second to the method by which its conclusions were to be discovered. A little before the above passages Laurentius had written that observation is not enough to produce knowledge of causes and that to gain this knowledge the student must read or hear the teachings of the authorities.

"Anatomy may also be taught without dissection, and that either viva-voce, by the living voice of the Teacher, or by writing. For there are many things which cannot be knowne by inspection alone, which may notwithstanding in good and apt words be taught, and so compassed; as namely why the Muscles are such and so many, why of such figure, magnitude, and the like: and for this cause, the Monuments and labours of olde and new Writers in this kind must be diligently travailed in." [My italics] (26)

Side by side with this belief in the separation of practical and contemplative anatomy and the lack of necessity for finding out the causes of the working of the body for

oneself was the attitude of Laurentius to the initial discovery of causes. We have seen that Laurentius had contrasted the working of the hand and of the mind. The way in which he described the action of the mind is similar to Sanctorius's belief that the mind creates universal causes by itself and not by any logical induction from knowledge or observation of particulars. This impression is strengthened when Laurentius elaborated on his description of contemplative anatomy:-

"If Anatomy be taken in the latter signification, it is defined a 'Science or Art, which searcheth out the Nature of every part, and the causes of the same Nature'. I call it a Science, because it hath universall or general Theoremes or Maximes, and common notions, out of which, being the First, true immediate and best known, all demonstrations are framed." (27)

This is similar to the a priori idea of causality that was to be formulated by Descartes; but, as I have shown in the case of Sanctorius, Laurentius did not feel it worthwhile to think anew the 'universal theorems and common notions' of the explanations of man and the world. Instead both men believed that these universal theorems having been thought of once, it was enough for the student to learn them.

Again, the dichotomy between observation and basic theory is present. Observation is what is important and open to debate, whereas the basic theories of physiology have already been discovered. The view of the creation of these theories by the mind as propounded by Sanctorius and Montanus and implied by Laurentius, meant that new discoveries in the field of observational anatomy would not affect the theories

of contemplative anatomy. For contemplative anatomy was explicitly separated from observational anatomy by the a priori nature of universal causes.

If this distinction between observation and theory is valid then the question must be asked what Laurentius meant when he wrote that man contains in himself the pattern of all things. I think the answer to this is to be found in the medieval idea that I mentioned before, that history is fable. The body gives us a picture of how things are and not why they are so; for the anatomy of the body does not supply us with the principles that explain the working of the body. When he described the workmanship of God, Laurentius wrote of the vessels from the heart nourishing and refreshing the body: as "the fountains and wellspringes of the humane Nature".⁽²⁸⁾ Earlier, Laurentius wrote that the Divines call man "'All things', not for matter and substance, as Empedocles would have it, but analogically, by participation or reception of the several species or kinds of things."⁽²⁹⁾ Thus the pattern that the body gives us of the world is a metaphorical pattern.

There is a clearer indication that the knowledge which anatomy of the body gives, apart from its specific medical use, is of the nature of a fable or allegory of the outside world. This is when Laurentius, in chapter V, suddenly delivered a political homily and displayed his highly conservative political views:-

"And if both Princes and Peasants would weigh and consider the mutuall offices between the principall and ignoble parts, Princes might understand how to rule

and Peasants how to obey. Princes may learn of the brain how to make laws, to govern their people; of the heart, how to preserve the life, health and safety of their citizens; of the liver they may learn bounty and liberality . . . As for the meaner sort of people they may easilie understand by the ministering and servile organs, what bee the limits of service and subjection. For the parts that are in the lower bellie do all serve the liver; the stomach dooth concoct the meat, the Guts distributeth and divide it, the veins of the mesenterie prepare it; the bladder of Gall, the Milt and the Reines, do purge and cleanse the princely Palace and thrust as it were out of the kitchen, downe the sink, all the filth and garbage . . . And if any one of the [the parts] do any time faile in their duty, presently the whole Household government goes to ruin and decay." (30)

Laurentius has drawn out the analogy of man and the world into the political sphere. However it is still only an analogy. If we do take the meaning of anatomy as an allegory relating to the physical and moral phenomena of the world, then the storms and earthquakes which the Paracelsan Quercetanus (Du Chesne) described as occuring in the stomach can be seen as allegory made real. (31) Laurentius did not go as far as the Paracelsans. He did not state that in the body can be found in miniature the meteors and storms of the greater world. The body contained "the seeds of all these things" and it is "'All things', not for matter and substance . . . but analogically." It would have been surprising, indeed, if a professor at Montpellier and a royal physician had been a Paracelsan, but he was not so far away from being one in some respects. However despite the elements of Platonism, Neoplatonism and the similarities with the Paracelsans, to be found in his work, Laurentius remained always a pillar of the Galenic establishment.

Other Anatomists

The views of Laurentius are the most fully developed of those that I have come across. Laurentius, however, was not an isolated example. The tradition of writing introductions of the kind which Laurentius published seems to have been developed in the sixteenth century; there is an element of this tradition in Vesalius but it is found more frequently and fully in the later part of the sixteenth century.

The Anathomia of Mondino Da Luzzi (1316) was, as I have stated before, the first European attempt in the middle ages to write an account of the human body based on an actual anatomy. The Introduction that Mondino wrote was based on the Galenic books available and on Averroes and Avicenna. There is hardly any of the material which is to be found in Laurentius. The reasons that Mondino gave for writing the Anathomia are of a gently literary nature:-

"As Galen, following the authority of Plato, hath said in the seventh book of his Methodus Medendi a work in any Science or Art is published for three reasons: first for the satisfying of friends, second for the useful exercise of the faculties, and third as a remedy for the forgetfulness which doth come with lapse of time. Moved by these I have projected a work for my pupils in Medicine." (32)

Mondino did not convey the sense of exaltation which the sixteenth century anatomists felt when describing man. Only when Mondino explained how man differed from the brutes does he elevate man, but even then the description is an attempt to explain the form of man and not to express his nature. Man differed from the brutes in his form:-

"For that man hath a most perfect form which he shareth with the Angels and Intelligences that rule the Universe. Thus are all his senses of right in the upper part of his body.

"For the end to which he was made. For he is thus upright that he may understand, and for this there serve the senses and notably, that of sight as is seen in the preface of the *Metaphysics*." (33)

The only element of Laurentius's Introduction which is to be found in the *Anathomia* is the microcosm-macrocosm analogy. The analogy was made by Mondino in a very simple manner, though as Charles Singer has shown⁽³⁴⁾ the analogy was an important part of medieval thought. Mondino wrote that man is named

"Microcosm that is the smaller world because, like the world the Macrocosm, he hath an upper and lower (form)." (35)

Man did not possess in the eyes of Mondino the majesty and glory that he was to have in the sixteenth century. This humility is in sharp contrast to the certainty in man's worth that breaks through the polished elegance of Vesalius's Preface to the *Fabrica* of 1543. Here he expressed in the Preface dedicated to the Emperor Charles V, within a short space the gist of what Laurentius was to develop at greater length; he wrote:-

"It is my opinion that out of the whole Apolline discipline, and so the whole of natural philosophy, nothing could be produced more pleasing or acceptable to your Majesty than an account from which we may learn about the body and the mind and furthermore, about a certain divine power arising from a harmony of both - indeed, about ourselves, that which in truth is the study of man." (36)

Vesalius then went on to say that despite the Emperor's interest in mathematics:-

". . . perhaps you sometimes delight in considering the temporary lodging and instrument of the immortal soul, a dwelling that in many respects corresponds admirably to the universe and for that reason was called the little universe by the ancients." (37)

Vesalius's argument is muted in comparison with the tone of Laurentius, yet Vesalius does use the same arguments as Laurentius. In the Preface of the Fabrica Vesalius had argued for the unity of the various branches of medicine and for the usefulness of anatomy in achieving this unification. However, when he tried to convince the Emperor of the worth of anatomy, he appealed to the non-medical factors of religion, knowledge of self and of the world. Vesalius was really trying to answer the question 'why practice anatomy?' which a member of the general public might have asked. The answer that Vesalius gave embraced those elements which the educated public would consider proper motivations for one's work - the glory of God and man and knowledge of oneself and the world.

It is unlikely that Laurentius felt very defensive about the value of his work. It would, however, be pleasant to speculate whether the much greater length of Laurentius's introduction was not due to the fact that anatomy had expanded into an academic industry by the 1590's and that the general public might still be sceptical of what was essentially the cutting up of dead bodies with the tools of the butcher. If that were so Laurentius might have felt the need for a long defence of anatomy aimed at the layman.

The degree of glorification of man and the references to Plato and Trismegistus seem to have been a phenomenon of the end of the sixteenth century and not of the middle of the century. Caspar Bauhin, with whom Laurentius would not have cared to have been joined, for as we have seen, he had dared to contradict Galen, produced introductory remarks similar to those of Laurentius. In his Institutiones Anatomice^a of 1604 Bauhin quoted the opinions of Trismegistus, of Plato, of Pliny and of Favorinus as had Laurentius. Bauhin opened his Dedicatory Epistle with the words "Mercurius Trismegistus whose extant writings express nothing but the profound and sublime . . ." (38) and went on to cite the passage in the Asclepius of man the great miracle. The idea of the body as the microcosm and epitome of the world was also repeated by Bauhin. (39) However he wrote at much shorter length than Laurentius and did not explore the microcosm-macrocosm comparison or the details of how man can gain knowledge of himself and of God, nor did he discuss the nature of anatomy in the analytical manner of Laurentius.

Nevertheless, in Vesalius, Laurentius and Bauhin, once the introductory matter is disposed of, there is barely any mention of the use of anatomy in acquiring any kind of knowledge other than medical. One is left with the impression that it was a rather pointless form of traditional exercise which anatomists felt they had to go through. However, forms of tradition which reflect the current desire to glorify man should not be taken lightly. For this reason I feel that

any attempt to explain man by means of principles derived from other, lower, phenomena (reductionism) would have been contrary to the emotional feeling of the sixteenth century. Even the Paracelsans did not lower man's position on earth.

The way in which the anatomists describe man may be a form of tradition and have little effect on their practice of anatomy, yet I think that it expresses an inhibition. A certain type of philosophy had placed man in this glorified position, a different type might lower him. At the conscious level this was articulated as the idea that the fundamental explanations of the world had been worked out by the ancients and that there was no need to search for new explanations.

Helkiah Crooke, in his own preface to the 'questions' or 'controversies' that Laurentius appended to the First Book of the Historia Anatomica, expressed this belief that the basis of knowledge could not and should not be changed:-

"There is and will alwaies be left Locus Philosophandi, scope enough, even in this little World for such as list to exercise themselves; and many have with no small commendations made prooffe of their agility, yet we must needes acknowledge, that the Groundworke of the building, and not onely so, but the whole frame was by the ancients reared up; and therefore now if any Ornaments be added, they must be fitted thereunto. Wherefore, we have laboured to bring all the subtilties and novell inventions of the later Writers, to the Touch-stone of the ancients Monuments; that as no man should be defrauded of his due Commendation; so the Crown may remaine, where with so much dust and sweate it was gloriously merited." (40) [My italics]

The words that I have italicised might serve as the epitome of this thesis; what Crooke has done is to spell out what

before was implicit. Both Laurentius and Crooke did this and it may be that they felt that the static view of knowledge that had prevailed up till then was being threatened. This feeling may have been what induced Laurentius to write at such length about anatomy and with such praise.

Change in Physiology

When Vesalius wrote the Fabrica in 1543, he set out to correct the observational mistakes of Galen who, he felt, had not dissected human bodies but those of monkeys. Vesalius did not try to set up a new physiological system in place of Galen's. Indeed, if we ignore Paracelsan and alchemical medicine, no-one until 1628 tried to replace the Galenic system in medicine.

However, some physiological debate was started near the end of the sixteenth century by men like Spigelius, Bauhin, and Caspar Hofmann. As we have seen, Bauhin and Hofmann developed an Aristotelian view of the Galenic system. William Harvey who, like Hofmann, came from North Europe, studied at Padua and then returned to his country, was an Aristotelian. I have described in Chapter Three the Aristotelian interpretation of the spleen's function to which all three men subscribed. However, up to 1628, the date of the publication of Harvey's De Motu Cordis, the development of controversy about physiological theory was really between the adherents of the old authorities - Aristotle and Galen. To modern eyes there seems little threat of change since the

fundamental principles were the same on both sides. Nevertheless the very fact that there was a debate going on might make some-one like Laurentius, seeing the Galenic position attacked, feel that the whole basis of knowledge was at risk.

Physiology and the Form of the Text Books

The first impression that one has of books of anatomy and physiology written between 1543 and 1628 is of the lack of the characteristics of a modern research paper. It would be fair to say that these first appear in Harvey's De Motu Cordis. That Harvey's book has been seen as the first example of experimental biology may owe as much to the form of the book as to the content. For if Harvey's results had been buried in the depths of a magnum opus such as the Fabrica, then the clear-cut division between the old science of the sixteenth century and the new science of the seventeenth which some historians believe the De Motu Cordis represents might have been obscured.

The De Motu Cordis has the characteristics of a certain terseness, a lack of large numbers of references and of side-tracking in order to answer old arguments, and, of course, originality of thought. The problem - the way in which the blood moves - was a specific and circumscribed issue, which Harvey tried to answer by developing differing arguments. These all led to the same conclusion, that the blood moves round in a circle.

Now, the point I want to make is that in the case of

physiology, though not anatomy, no-one would have said in the sixteenth century that the books and treatises being written then did not contain good research - for the concept of research into basic explanatory theories did not really exist in orthodox medicine.

I have looked at the amount of space devoted to the function of the spleen by medical writers in the sixteenth century and there does seem to be an increase. The anatomy of the spleen receives the longest treatment and a large number of references at the hands of Vesalius, Real^dso Colombo and Valverde, whilst the physiology of the spleen is only briefly mentioned with only a few references and those mainly to Galen.

After Ulmus wrote his tract on the spleen (1578) and developed the Aristotelian alternative of the spleen's function, the amount of space given over to the physiology of the spleen rapidly increased so that in the Theatrum Anatomicum of Bauhin (1592) equal space was given to the physiology and to the anatomy of the spleen. The number of classical references in the physiological section of Bauhin's book also increased and Bauhin cited the respective modern adherents of Aristotle and Galen. Spigelius and Bartholin also have large sections on the function of the spleen.

However when one looks at the Syntagma Anatomicum of Veslingius (1641), it is clear that we have come back almost full circle. The Aristotelian view had triumphed in the

medical establishment. Veslingius did not feel the need to cite many authorities. He accepted the Aristotelian view as being the orthodox one and, as I have shown, he sought to test the validity of this view by designing a specific experiment (ligature of the lymphatic glands). Veslingius did not feel that he had to decide between the physiological views of the ancients, but rather he tried to find out whether they were right or wrong; before, the question had always been which of the alternatives was right. The idea that all the basic alternative functional theories could be wrong was a view which did not occur to the sixteenth century, but for Veslingius it was very possible to envisage such a situation. Veslingius was also a seventeenth century man in that he did not feel the necessity to show his knowledge of the ancient authorities in order to prove to his readers that he was learned.

If we consider the middle of the sixteenth century, the end of the century, and the period around 1640-1650 and try to understand what type of inquiry was going on into fundamental medical theories, three very distinct impressions emerge. In the 1550's anatomy was rapidly developing whilst physiology was relatively quiet; between 1580 and 1610 physiological debates between the adherents of various ancient authors were taking place; whilst in the middle of the seventeenth century the spirit of independence which was apparent in anatomical observations after 1543 emerged in discussions of physiological function.

'This Setting Part of Time'

In 1599 Richard Surplet translated the Discours de la conservation et de l'excellence de la vue of Laurentius, Surplet wrote in his introductory remarks to the reader:-

"Considering (gentle reader) the lamentable times and miserable daies, that are come upon us in this last and weakest age of the world, partly by reason of the comunes and multitude of infirmities, partly by reason of the strangenes and rebelliousnes of diseases breaking out more tediously than heretofore: and considering herewithall how apt and prone the multitude of people are to affect, nay (which is more) to dote upon and runne after the painted crew of seeming Phisitians and prattling practisers both men and women." (41)

If the reader wished to avoid this, Surplet concluded, then he should buy Laurentius's book.

This pessimistic view of the world was expressed in a period when changes were beginning to take place in the basic theories that explained man and his world. In the world at large Paracelsan alchemy was challenging the traditional Aristotelian picture of the physical constitution of the universe. Galileo was to make the Copernican system a feasible reality a few years after Surplet had written these words.

As we have seen in the world of orthodox medicine the changes do not appear to us to be very far-reaching; for what seems to have been happening was the juggling of the view of one ancient authority with that of another. Yet Crooke, Laurentius and Surplet all express anxiety, and the very fact that there was debate in an area which before had been quiet must have made them uneasy. The reaction of Laurentius was to emphasise at great length the correctness

of Galen. The reaction of another medical man, Daniel Sennert, was very different.

Daniel Sennert was born in 1572 at Breslau. He became an M.A. at Wittenberg and studied at Leipzig, Jena and Frankfurt am Oder; he returned to Wittenberg, took his M.D. in 1601, and became a professor there in 1602 where he introduced the study of chemistry.

Sennert attempted to effect a compromise between Paracelsan and Aristotelian-Galenic medicine and besides this he believed in a corpuscular explanation of chemical changes. He was a man full of the ancient learning who believed in the possibility of new knowledge.

I have chosen to look at Sennert's writings because he does not represent as radical a break with men like Laurentius as someone like Descartes does. However, despite Sennert's close sympathy with Galenic medicine, he differs from Laurentius in that he was able to see that one could think of new "universal or general theoremes or maximes and common notions," as Laurentius had put it.

In the Hypomnemata physica of 1636, which was translated by Nicholas Culpeper and Abdiah Cole in 1660 as the Thirteen Books of Natural Philosophy, there is a close resemblance in the description that Sennert gave of man with that of Laurentius. In the first chapter Sennert wrote:-

"It remains now that we should treat of MAN, who being the Rule and Measure of al living creatures and being compared with the rest, may be said to comprehend them all, because he is furnished with al their faculties and endowments, with the consideration therefore of Man, we shall conclude our Treatise of Natural Philosophy." (49)

Sennert then stated that man consists of body and soul and in the second chapter, 'Of the Body of Man and its Functions' he wrote:-

"Now the Soul of Man, since it is the Rule (in a manner) of all things living . . . it must also of necessity have the most noble body of all which ought now to be described as the Rule of all the rest." (43)

The tone of Sennert's description of man echoes that of Laurentius, yet Sennert was able to look back at the modern anatomists and analysed their contributions:-

"Very many men of this Age have diligently written of Anatomy amending and increasing the doctrine of Galen. And amongst them chiefly Vesalius, Fallopius, Columbus, Sylvius, Piccolomineus, Laurentius, Platerus, Bauhinus, Casserius, Fabricius, Riolanus, Spigelius and many more." (44)

The insight of Sennert was correct, for despite the differences between the Galenists and the Aristotelians, the work of the anatomists had been to amend and increase the doctrine of Galen. Sennert was looking back at a historical situation which he felt had passed and which he was not part of - unlike Laurentius.

One reason that Sennert could experience this feeling of detachment was that he could envisage changes in the basic theories of biology and physics. In the Introduction to the Natural Philosophical Discourses, also contained in the Thirteen Books of Natural Philosophy, Sennert wrote that, "there are two things which chiefly draw the minds of men from truth, and hinder the growth of all disciplines; viz A servile kind of credulity, and a rash desire of Innovation." Sennert continued:-

"neither would I be of the number of those rash innovators, whether Paracelsians or Chymists or howsoever otherwise called, who endeavour wholly to banish from the schools the ancient philosophy which is come to us chiefly out of the writings of Aristotle; nor yet would I be reckoned amongst them who are not ashamed in this age of ours publicly to profess, that they had rather err with Aristotle and Galen than speak the Truth with any later Author." (45)

The correct way of approaching Aristotle, Sennert wrote, was to:-

"Let it be counted a comely and a decent thing to cite the Testimonies of Aristotle as of a prime Philosopher for his opinion, and to produce as many of them as may be: but if weighty reasons be not added, a mind desirous of the truth will not be contented with these alone." (46)

Despite the second-hand and compilatory frame of Sennert's mind, there is no doubt that on the crucial issue of having the capacity to doubt the fundamental theories of the ancients, Sennert was a man of the seventeenth century. In the Introduction 'To the Reader' Sennert repeated a criticism that had been made against himself "by a certain envious and malignant person." This criticism^{ci} is full of the pessimism of a man who saw the ideas of the ancients being challenged and so sought to protect his disappearing view of the world by attacking his present age and stating that there is no way of improving on the ancients. By repeating the criticism Sennert wanted to draw attention to his own belief that the men of his age could improve on the ancients.

The criticism of Sennert was as follows:-

"That certain cross-grain'd Wits are arrived to so great a degree of Wantonness, and vaine glorious boldness, that they are not ashamed to overthrow and drive out of the Schools, the Doctrine and Basis of most true Principles, celebrated and

preserved by the general consent of sincere and learned Antiquity, and rightly used to this very day, against which every sound witted and pious person makes conscience to open his mouth; and to establish their own absurd, false, stinking, HERETICAL and BLASPHEMOUS Paradoxes in their room; and by so doing to corrupt all good disciplines, destroy the studies of the Liberal Arts, reduce barbarism, and in this last dreggy Age of the declining World to take away all true knowledge of things." [My italics] (47)

Sennert's rejoinder to this outburst was gentle, and in so replying he contradicted the assertions of Laurentius that the student should rely on the authorities for learning basic theories and that universal causes are created by the mind without reference to experience. Sennert wrote

"And though Aristotle were the most ancient of all philosophers; yet he cannot therefore be taken for the Rule of Truth. For Truth is the squaring of the Notions which are in the Understanding, not with the Notions of another man, but with the things themselves." (48)

In these two sentences Sennert expressed the passing of an age. Sennert was not a Descartes or Galileo, yet his middling intellect had grasped two of the essential constituents of the thought of such men as Descartes and Galileo. No longer could one say "and therefore now if any Ornaments be added, they must be fitted thereunto," as Crooke had done, even if Sennert rather paradoxically tried to attempt this. Nor could any scientist who thought of himself as a 'modern' divorce experience from universal causes as some of the most 'modern' of the medical writers had done in the sixteenth century. With this new feeling in the air the major themes of my thesis come to an end. What it meant to be a man who

could not adjust to the new situation I leave Dr. Thomas Browne in U^{rn} Burial to express:-

"'Tis too late to be ambitious. The great mutations of the world are acted, our time may be too short for our designs. To extend our memories by Monuments, whose death we daily pray for, and whose duration we cannot hope, without injury to our expectations in the advent of the last day, were a contradiction to our beliefs. We whose generations are ordained in this setting part of time are providentially taken off from such imaginings." (49)

NOTES - CHAPTER I

Full details of books referred to in the Notes can be found in the Bibliography.

1. In this thesis I shall not consider the ideas on bile which form part of the humoral theories of countries outside Western Europe such as India.
2. For a modern study on the three types of melancholy of which Durer's painting represents the first see: R. Klibansky, E. Panofsky and F. Saxl: Saturn and Melancholy (1961)
3. Aristotle: Problems Book XXX.1 (Loeb edition 1957) p.155-169
4. Galen: On the Natural Faculties (1963, abbreviated as Nat. Fac.): p.307-309
Also Galen, On the Usefulness of the Parts of the Body (1968, abbreviated as 'Use of Parts') p.209
5. Galen, Use of Parts: p.222
6. Galen, Use of Parts: p.226
7. Galen, Use of Parts: p.252-253
8. Galen, Use of Parts: p.206 and p.232
9. Galen, Use of Parts: p.232-233
10. Galen, Use of Parts: p.255 and p.233
11. Galen, Use of Parts: p.255
12. Galen, Nat. Fac.: p.61
13. Galen, Nat. Fac.: p.207-209
14. Galen, Nat. Fac.; p.209, footnote 1.
15. Galen, Nat. Fac.: p.203
16. Galen, Nat. Fac.: p.203-205
17. Galen, Nat. Fac.: p.205. Galen was referring to Aphorism twenty-four of the Fourth Section of the Aphorisms

18. Galen, Nat. Fac.: p.205
19. Hippocrates: De Morbis IV, 33 (Littre', Vol VII, p.542)
20. See Introduction to Use of Parts page 45 note 193
21. Galen, Nat. Fac.: p.205
22. Galen, Nat. Fac.: p.205-207
23. Galen, Nat. Fac.: p.207
24. Hippocrates, Aphorisms, Aphorism twenty-two, Section IV translated by F. Adams in Great Books Vol 10, p.136; to be referred to as Hippocrates (Adams)
25. Hippocrates (Adams), Aphorisms: Aphorism twenty-four Section IV, p.136
26. Hippocrates (Adams), Aphorisms: Aphorism forty-three Section VI, p.141
27. Hippocrates (Adams), Aphorisms: Aphorism forty-eight Section VI, p.141
28. See, for instance, Hippocrates (Adams) Epidemics Case X, Book III, Sect. III, p.62, where the daily change in the appearance of discharges is noted and it is explained as being "probable that the cure was owing to the bilious evacuations and the sweats."
29. Hippocrates (Adams): On Regimen in Acute Diseases: Section 16, p.34
30. Hippocrates (Adams): On Regimen in Acute Diseases: Appendix, Section 5, p.36
31. Hippocrates (Adams): On Regimen in Acute Diseases: Appendix, Section 3, p.35-36
32. Hippocrates (Adams): On Ancient Medicine: Section 22, p.8
33. Plato: Timaeus translated by H.D.P. Lee (Penguin Books), p.98, and to be referred to as Plato: Timaeus (Lee)
34. Plato: Timaeus (Lee), p.110-111
35. Plato: Timaeus (Lee), p.111
36. Plato: Timaeus (Lee), p.111
37. Plato: Timaeus (Lee), p.113

38. Plato: Timaeus (Lee), p.114
39. Aristotle: Parts of Animals, translated by A.L. Peck (Loeb edition 1961), Book 3, Chapter 7, p.261-263.
40. Galen: On Anatomical Procedures, translated by W.L.H. Duckworth, Book XI, Chapter I, p.70-71. Only the first eight Books and the beginning of the ninth were available in the sixteenth century so this passage could not have had any influence on the medical writers of that time
41. Galen: Nat. Fac.: p.209
42. Galen: Nat. Fac.: p.209
43. Galen: Nat. Fac.: p.209
44. Galen: Nat. Fac.: p.209-211
45. W. Pagel: "Van Helmont's Ideas on Gastric Digestion and the Gastric Acid" (Bulletin for the History of Medicine 1956. 30 pp.524-536)
46. Plato: Timaeus (Lee), p.111
47. Galen: Nat. Fac.: p.211
48. Galen: Nat. Fac.: p.211
49. Galen: Nat. Fac.: p.211-213
50. Galen: Nat. Fac.: p.213
51. Galen: Nat. Fac.: p.213
52. Galen: Nat. Fac.: p.213
53. Galen: Nat. Fac.: p.213
54. Galen: Nat. Fac.: p.207:- "For, generally speaking when the spleen is drawing the atrabiliary humour into itself to a less degree than is proper, the blood is unpurified, and the whole body takes on a bad colour."
55. Galen: Nat. Fac.: p.213
56. See note 38
57. Galen: Nat. Fac.: p.213-215
58. Galen: Nat. Fac.: p.217

59. Galen: Nat Fac.: p.9

60 Hippocrates (Adams): On Ancient Medicine, Section 13,
p.4

NOTES - CHAPTER II

1. Mondino: Anathomia (Translated by Charles Singer in The Fasciculo Di Medicina Vol. II, 1925 Florence) See for instance p.70 " . . . by the heat of the arteries the crude blood which is to nourish the spleen may be refined and digested, because the spleen hath a fine substance into which it must receive the crude melancholic humour."
2. Galeno Attributus Liber De Utilitate Respirationis in Opera Omnia Latine in septem classes digesta . . ., (1556), (to be referred to as De Util Resp)
3. De Util Resp p.62 verso

"Dicit enim Aristoteles ultimam digestionem cibi fieri in corde. Sanguinemque in ventribus cordis generari. Dicit quoque Aristoteles primum et utilissimum instrumentum omnium sensuum est cor, non autem cerebrum, ut quidam asserunt . . . "
4. De Util Resp p.62 verso

"hoc autem est indicium, quia impossibile est dolorem fieri in aliqua parte corporis, quam fiat passio in corde. Et si multus fuerit dolor, facit syncopen cordis."
5. See, for example, Book Eight of the Use of Parts where Galen pours scorn on Aristotle.
6. De Util Resp p.64 verso

"Cor . . . attrahit etiam succum cibi a concava vena hepatis quia ut ait Aristoteles in corde perfecte digestus sanguis fit. Rursus autem cor attrahit ab intestinis succum cibi aliunde quam per hepar, id est per mediam arteriam, arteria enim quae protenditur a corde per dorsum, et coniungitur mesenterio, non transit per hepar, cum dicat Aristoteles in hepate nulla est omnino arteria."
7. De Util Resp p.64 verso

"Dico etiam mesaraicum, per quod transit succus cibi ab intestinis per totum corpus, non solum continuari venis hepatis, immo etiam arteriae cuidam procendenti a dorso, et non transeunti per hepar, sicut testantur omnes qui de anatomia scripserunt: ex quo manifestum est, succum cibi non omnino transmitti ad venam hepatis, immo etiam partim ad arteriam."

8. De Util Resp p.64 verso

"Dico etiam quod quemadmodum hepar, ita quoque ~~est~~ ~~et~~ et splen attrahit succum cibi ab intestinis per medium mesenterium cui continuata est vena splenis, quemadmodum et hepatis vena. Unde splen, ut ait Aristoteles recte hepar sinistrum potest appellari. Item a corde protenditur vena ad splenem, quemadmodum, ad hepar, per quam cor attrahit sibi succum cibi a splene quemadmodum ab hepate."

9. De Util Resp p.64 verso

"Miror autem quampurimos antiquorum ignorasse usum splenis in corpore humano; alios autem opinatos nosse penitus errasse. Solus vero Aristoteles in libro de particulis animalium diligenter supra hoc scripsit, qui fuit verus solus veritatis ostensor."

10. Sherrington: The Endeavour of Jean Fernel (Cambridge, 1946)11. J. Fernel: De Naturali Parte Medicinae (Venice, 1547)

(to be referred to as De Nat Parte Med) p.178 recto

"Lienis porro parte concava venam gerit a portis iecoris allatam, qua is a squallido illo et melancholico humore iecur expurgat."

12. Fernel: De Nat Parte Med p.178 verso

"assidua deinde opera summaque administratione hunc elaborat, comminuit, exterit et in tenuiorem quoad licet succum commutat, ad hanc quidem actionem tum robur innati caloris, tum perpetuam arteriarum (quae illic multae sunt et ingentes) pulsationem accommodans."

13. Fernel: De Nat Parte Med p.178 verso

"Qui in splenem allicitur sanguis eum qui in iocinere continetur crassitudine superat: verum cum in illius venis et arteriis elaboratus fuerit, non univertus neque crassior illius portio, sed tenuior duntaxat lienis fit alimentum, et in eius carnem sensim illabitur."

14. Fernel: De Nat Parte Med p.178 verso

"Id autem quamvis tenue sit, nequaquam tamen rubrum est, sed subnigrum lienis colore: quemadmodum qui sanguis iecur alit crassus est et ruber: Sic enim conveniebat unumquodque familiari et cognato sibi humore nutrir. Crassior autem melancholici humoris portio quae lienis vi nec molliri nec subigi potuit, tanquam ad nutriendum inepta, in os ventriculi portio ductu tanquam eructando eiicitur. Haec quidem cum

austera sit et acerba, ventriculum astringit et in angustum adducit, ut inde omnis illius actio firmior sit et validior."

15. C.D. O'Malley: Andreas Vesalius of Brussels (University of California Press 1964)

16. Vesalius: De Humani Corporis Fabrica (1543, to be referred to as Fabrica) Book V Chap. IX, p.511

"Non enim is, ut medicorum turba arbitratur, sanis alioquin hominibus extra costas, quasi ad abdominis medium anterioraque, non adamussim costis, ceu tutissimis vallis septus, prominet . . . "

17. Vesalius: Fabrica p.512

"Necque inutiliter hominis viscera in aqua nonnumquam elixantur aut saltem ut magis concresecat sanguis, in calidam submergentur. Solet enim fluxilis adhuc sanguis in iecore, et liene, et pulmonibus etiam quo minus apte spectari singula queant, impedimento esse. Potissimum autem in liene tentandum hoc duxi quod de ipsius usu vehementer ambigerem [my italics]

18. Vesalius: Fabrica p.512

"venasque et arterias longe aliter quam in iecore, pulmonibus et renibus dispersas intuerer. Etenim lienis substantia crasso nigroque admodum, sed solidioris spongiae, aut, levioris pumicis modo . . . frequentibus fibris filamentisque non insigniter validis duntaxat implicita."

For the rendering of the last part of this passage, "numerous delicate fibres and filaments" I am indebted to O'Malley's elegant translation (O'Malley: Vesalius p.172)

19. Vesalius: Fabrica p.512

"Per huius enim corpus, et si per multas venas et arterias inseri certo cognoscamus, nullae tamen quemadmodum in iecoris et pulmonum corpore, per substantiam ipsius dispersae animadvertuntur, nisi perquam rarae, eademque admodum graciles, non aliter quam si simulatque lienis sinum vasa ingrediuntur, in innumeram ramorum sobolem diffunderentur, adeo tenuium, ut cavitare carentes fibrae potius quam vasa nuncupandi essent.

20. Vesalius: Fabrica p.512

"Necque profecto tenuis sanguis quo lienem enutriridamus raritatis substantiae lienis sola causa esse videtur, sed innumerus ille fibrarum (vix ausim enim arteriarum dicere, et venarum) implexus. Talis mihi lienis in sanis hominibus apparuit substantia."

21. Vesalius: Fabrica p.512

"Haec idcirco recenseo, ut huius visceris substantia et usus (si modo de eo quem Galenus ipsi tribuit, dubitare fas sit) a studiosis sedulo indagetur."

22. Vesalius: Fabrica p.511

"At reliqua ipsius superficies non ita ut iecoris, aut renum laevis est, sed obscuris quibusdam et leviter prominentibus tuberibus, ad eam fere formam qua elephantiasi morbo insigniter laborantium cutis inaequaliter extumescere consuevit. Necque illi solum inaequali cutis superficiei respondet lien, verum etiam colorem quoque illius affatim exprimit. Parisiis enim in divi Lazari monasterio, et in plerisque superioris Germaniae agris, et alibi quoque elephantiasi morbo affectos vidi, nigricantem lienis humani colorem superficiemque, exacte referentes, non secus quam si quis ex liene eos confinxisset."

23. Vesalius: Fabrica p. 512

"In quodam laborante elephantiasⁱe, quae nondum penitus radices egerat, turgidiorem maioremque lienem reperimus: in reliquis autem, sano similem."

24. Vesalius: Fabrica p.512

"In cive Patavino, qui annis tribus carcere detentus, tandem nigro arquato defunctus, sectioni publicae adhibitus fuit, lienem praeter caetera minus crassum latumque et exiguum omnino reperimus."

25. Vesalius: Fabrica p.512

"Qui Montisselis suspensus, ad publicam sectionem Patavium advectus fuit, adeo grandem ostendebat lienem, ut modice admodum iecoris moli cederet, et anteriori iecoris parti adnatus, anteriori quoque ventriculi sedi exporrigeretur. Lienis eius substantia, sanorum visceris substantiae penitus respondebat."

26. Vesalius: Fabrica p.512

"Adolescens hic fuerat candidissima et glabra cute, minimeque natura melancholicus . . . extremum suae tragoediae actum egit, et morum potissimum occasione a studiosis sectioni fuit adhibitus. Galli sacerdotis Bononiae in Xenodocio aqua subter cutem mortui, lienem albidum, sed exiguum adinveni."

27. Vesalius: Fabrica p.513

"Atque haec est lienis, situs, formae, et partium enumeratio."

28. Vesalius: Fabrica p.513

"Quam iuste vero corporis nostri architectus illa dispensaverit, singulorum edocebit usus, et functio: de qua non medicorum modo proceres, verum et philosophorum praecipui dissenserunt."

29. William Harvey: The Anatomical Lectures, edited by Gweneth Whitteridge p.129

30. Vesalius: Fabrica p.513

"Aristoteles lienem adulterati iecoris loco recenset. Eodem modo autor libri de Respirationis usu, quem Galeno falso tribuunt, praeter alia quaedam de venis, quae gibbo lienis inseri arbitratur, nugamenta, lienem ex ventriculo et intestinis confectum cremorem per venas ventriculi et intestinorum assumere, ac sanguificationis organum esse contendit. Huius sententiae nonnulli etiam medicorum subscribunt . . . "

31. Vesalius: Fabrica p.513

At qui caeteris dissectionis professoribus probabilior esse videtur lienis usus . . . ut lutosi faeculentique in iecore confecti sanguinis fit receptaculum: et quemadmodum tenuiori leviorique recremento bilis vesicula reficitur, ita lienem crassiori et graviori suscipiendo extractum esse."

32. Vesalius: Fabrica p.513

"quod lien ad se per portae venae truncum, multiplici sobole eum adeuntem, tanquam familiare sibi alliciat exugatque: attractum autem conficiat, elaboret, ac suae nutritioni aptum reddat, sanguinem illum, et si crassus faeculentusque sit, rarum spongiosumque efficiens."

33. Vesalius: Fabrica p.513

"Ad quod praecipue opitulatur frequentes in lienem insertae arteriae, suo calore ad exactam sanguinis illius elaborationem strenue auxiliantes. Sed quod primarius praecipuusque huius actionis autor, lienis sit caro, etiam si non dicantur, manifestum esse neutiquam ambigo."

34. Vesalius: Fabrica p.513

"Atque ita etiam omnibus concessum est, lienem non universum sanguinem quem a iecore admittit, suaque insita vi allicit, conficere, ac in sui nutrimentum reponere: verum quicquid nutritioni ineptum continet, suaeque substantiae adaptari nequit, in ventriculum magni cuiusdam usus gratia revomi."

35. Vesalius: Fabrica p.513

"Primum enim omnes affirmant, succum melancholicum a liene ventriculum cructari, alii quidem per venam a liene in ventriculum pertinentem, alii per proprium quendam meatum, atque inde a ventriculo in intestina, et hinc una cum faecibus e corpore expurgari."

36. Vesalius: Fabrica p.513

"Porro venam illam, aut ut aliis arridet, meatum nonnulli simpliciter in ventriculum a liene duci scribunt: alii insertionis locum intrepide exprimentes, illum in superius ventriculi orificium implantari adiciunt."

37. Vesalius: Fabrica p.513

Nam alii perquam utile et amicum ventriculi functionibus hoc esse . . . sed alii quidem contenti sunt, si doceant, atram hanc bilem sua saporis qualitate, quam acerbam et acidam esse fatentur, omnes ventriculi functiones, quae in amplexu quodam consistunt, astringendo et colligendo corroborare, ac proinde ne incofectus a ventriculo cibus elabatur, prohibere."

38. Vesalius: Fabrica p.513

"Alii autem huic tantum usui non acquiescentes, iam dictis utilitatibus addunt, vim ventriculi appetitricem hoc excremento adeo incitari, ut eius praecipue usus gratia venam aut porum a liene in superius ventriculi orificium inseri statuunt: imaginatione solum, non sectionibus ita edocti. Ego sane de hoc recrementi lienis in ventriculum eruptione, et eius usu nihil affirmare audeo: neque etiam sectio ista luculenter quae tamen citra ullam controversiam Anatomes professores audacissime asserunt, mihi commonstrat." I am indebted to O'Malley (Vesalius p.173) for the translation from "sectio ista luculenter . . . to the end of the passage.

39. Charles Estienne: De Dissectione Partium Corporis Humani (Paris 1545). Estienne drew the connecting vein between spleen and stomach in the anatomical figure on page 180 of his book, he gave an explanation of the figure on page 181 and he mentions the connecting vein again in his chapter on the spleen on page 185.

40. The descriptions and translations concerning the cases of Marcantonio Belloarmato and of Prospero Martello are taken from O'Malley: Vesalius p. 202-203. In one or two instances I have altered slightly O'Malley's English

41. G. Fallopius: Observationes Anatomicae (Paris 1562)
p.108

"In lienis historia nihil est traditum ab eodem, quod penitus mihi non satisfaciat, nihilque habeo, quod a me sit addendum, nisi quod his Patavii publice cadaver secuerim, in quo triplicem lienem reperi . . . "

42. Vesalius: Anatomicarum G. Fallopii Observationum Examen (Hanau 1609) p.191

"Qui vero de lienis usu (nisi is etiam sanguini conficiendo sit accommodus) animum adhuc inconstantem geram, non est quod scribam, quum tu illum observationem, non fueris dignatus."

43. Realdo Colombo: De Re Anatomica. See the chapter on the spleen Book XI chapter VII, p.230-231, where Colombo describes the use of the spleen:-

"Lienis utilitas est, ut melancholicus sanguis ab illa attraheretur, cum praesertim eodem alendus esset."

44. Valverde De Hamusco: Anatome Corporis Humani . . . Nunc Primum a Michaelae Columbo Latine reddita (Venice, 1589 to be referred to as Anatome). p.266-267

" . . . ex ramo autem qui editissimo lienem adeuntium ramo proximus est paulo ante quam ad lienem pertingat, vena quaedam educitur, per sinistrum ventriculi latus, adusque os fere ipsius excurrens."

45. Valverde: Anatome p.267

"Id Romae Pontificatus Pauli Tertii vacatione, in Cardinali Cibone conspicuum evasit, qui sanguinis per vomitum reiectatione e vivis sublatus, dissectus fuerat."

46. Valverde: Anatome p.267

"Quo enim loci, unde sanguis profunde batur certiores redderemur, ventriculum exprimebamus, statimque lien . . . evidenter intumescere et contra expresso liene, ventriculus insigniter sanguine turgescere conspiciebatur, per huiuscemodi scilicet venam, quae notatu dignae amplitudinis erat, et proxime ad ventriculi os conscende--bat."

47. Valverde: Anatome p.187

"Lienis functio est sanguinem a melancholico succo emundare."

48. O'Malley: Vesalius p.267, writes of Valverde's "apparently limited experience of anatomy."

49. Caspar Hofmann: De Usu Lienis (Leyden 1639) p.17

50. Joannes Tagaultius: De Chirurgica Institutione . . .
(Venice 1549) Book 2, chapter 3, p.215

"Lienis vulnera cum munus habeat toti corpori
apprime utile ac prope necessarium, sitque (ut nonnulli
dixerunt) veluti alterum hepar, periculosa sunt."

51. Volcher Coiter: Externarum et Internarum Principalium
Humani Corporis Partium Tabulae (1572 Nuremberg)

p.22 "De partibus nutritoriis generales tabulae"
For the Latin text of my translations of this table
see photostat copy in the Appendix page 359

52. Coiter: Externarum . . . Principalium, . . . p.23

"De nutritoriis partibus tradituri auspicabimur
ab iis, quae in Anatomica administratione oculis nostris
primo sese offerunt."

53. Coiter: Externarum . . . Principalium . . . p.24

"Lien sanguinis limosi et melancholici expurgationi
destinatus, vocatur graece *επιλυμ* Lat: lien et
splen. Eius care vocatur etiam *παρεγχυμα* Aliae
eius partes peculiaria nomina non consequuntur."

54. Coiter: Externarum . . . Principalium . . . p.24

After giving the number and names of the kidneys,
Coiter wrote:-

"Glandulae, sive carunculae subalbae et durae,
papillis mammaram similes, atque angustissimis foramin-
ibus perforatae, quae vix capillum admittunt. Hae
praepediunt, ne sanguis cum sero effluat, atque ne
affatim serum transmittatur. De his Eustachius in
tractatu de renibus.

Glandula, ab Eustachio inventa, externae a peri-
tonaeo eductae membranæ rerum adhaerens, figura reni
similis . . . "

NOTES - CHAPTER III

1. I have not been able to find any definite information about Ulmus in any of the standard biographical reference books. In Jöcher's there is an entry to Franciscus Olmi who it is stated was the uncle of Ulmus.

2. Franciscus Ulmus: De Liene Libellus (Paris 1578, to be referred to as De Liene) page 2, recto.

"Superioribus annis, vir clarissime, cum anatomen publice profiterer, Lienisque fabricam inter alias corporis partes attentius contemplerer, non potui abduci quin alium huius visceris usum esse suspicarer, quam qui vulgo creditur. Hanc meam suspicionem auxit magni illius Vesalii de eadem re dubitatio. Itaque cepi egomet continuo mecum cogitare, ita uti soleo ubi quid in animo est dubii, remque ipsam paullo diigentius inquirere."

3. Ulmus: De Liene, page 4, recto.

"Quinque adhuc fuere de lienis usu opiniones. Primus Hippocrates scripsit Lienis in corpore munus esse, quod in alimento aquem est a ventriculo attrahere, non secus ac bilem a iecore trahit vesicula ipsi annexa."

4. Ulmus: De Liene, page 4, recto-verso.

"Alterius opinionis auctor fuisse videtur Aristoteles qui paululum a praeceptore deflectens, censuit Lienem a natura conditum esse, ut superfluos et excrementitios ex potu largiore genitos vapores divertat et attrahat ex ventriculo, quos post modum concoquat. Huius rei rationem adfert quod animantibus quae multum bibunt, cuiusmodi sunt quae sanguineos pulmones obtinere, magnus sit, et humidus . . . Iis autem qui minimum bibunt, cuiusmodi sunt quae exangues et fistulosos seu fungosos habent pulmones, aut non magnus, aut notae tantum gratia datus sit. Subiungitque ob id, per accidens necessarium esse Lienem, quemadmodum alvum et vesicam."

5. See Aristotle: Parts of Animals, book III, chapter VII, page 265-267 (Loeb edition 1961)

6. Ulmus: De Liene, page 4, verso.

"Erasistratus deinde sequuntus est qui, ut Galenus ait, voluit Lienem frustra factum esse a natura.

Erasistratii hanc praeceptoris negligentiam damnautes (ut idem Galenus refert) Lienem animantibus a natura tributum dixerunt, ut cliquatam ex cibis succum prae-pararet iecori, ad frugi sanguinis generationem. Quam sententiam aemulatus quidam recentiorum, dixit Lienem esse alterum iecur."

7. Ulmus: De Liene, page 4, verso.

Postremo Galenus, quem omnes deinceps sequuti sunt, cum Graeci, tum Arabes, Lienis munus esse contendit, crassum, faeculentum et melancholicum succum, a sanguine in hepate confecto secretum, attrahere ad sese, et eo veluti sanguinem purgare, non secus ac bilem flavam allicit vesicula sub iecore. Hanc autem suam opinionem firmat sex omnino rationibus: quarum prima haec est."

8. Ulmus: De Liene, page 6, recto.

"Primum falsum, quia vaporosa non est lienis substantia, quae vapore alatur: unumquodque autem simili nutriatur."

9. Ulmus: De Liene, page 10, verso.

"Sed neque hoc, neque illo modo attrahit lien sanguinis faecem. Principio quod non attrahat, ut ea nutriatur, docet rara, mollis et laxa visceris huiusce constitutio, quae tenue potius alimentum postulat . . . proindeque tenuiore egeat alimento, si modo perpetua esse debet, ut vere debet, alimenti cum alendo analogia, similiaque similibus nutriri debent."

10. Ulmus: De Liene, page 8, verso.

"Quartum argumentum sic eludere placet: Si ait Galenus, quatuor in corpore humores continentur, natura aliquod instrumentum paravit melancholico humori trahendo. Ego vero: Si quatuor in corpore humores continentur, natura aliquod pituitoso humori trahendo."

11. Ulmus: De Liene, page 11, verso.

". . . omittam interea inutilem succi huius a Galeno somnium usum, ad excitandam nempe appetentiam. In quo duplex ab eo committitur error: Primus est, quod aliam statuat vasorum a liene in ventriculum insertionem, quam sensus doceat. Quamvis enim a liene corpore prodeat vas illud quod venosum appellat ipse, non tamen in os superius ventriculi inseritur, ut ille ait, sed paulo supra medium ipsius corpus, sinistram versus: unde rami quidam tenues sursum ascendunt, non tamen ad os ventriculi usque."

12. Ulmus: De Liene, page 11, verso.

"Et si acida aut acerba est, appetentiam nihilo magis excitabit, cum appetentiae sedem non attingat: quoniam ita reiiceretur in medium ventriculi spatium, ad quod pertinet vas illud venosum dictum: unde gravis cum sit, in os ventriculi superius, ubi appetentiae sedem ille idem statuit, non facile ascenderet."

13. Ulmus: De Liene, page 6 verso - 7 recto.

"In lienosis enim sanguis tenuis esse consuevit et serosus, non autem limosus et faeculentus, qualem melancholicum esse vult Galenus."

14. Ulmus: De Liene, page 7, recto.

"Quid vero quod scirrhosum habentibus lienem sanguis tenuis et serosus apparet, ut videre est in hydrope et cachexia, quae ad duros lienis tumores consequuntur?"

15. Ulmus: De Liene, page 13 recto.

". . . sanguinis arterialis praecoctionem seu praeparationem appellabo. Duplicem namque in arteriis substantiam esse notum est: quarum una est ex aere quae spiritus nomen retinet, quoniam oculorum obtutum fugit, ratione tantum comprehensa. Altera ex sanguine in viventium pariter atque mortuorum arteriis vulneratis conspicua."

16. Ulmus: De Liene, page 13, recto-verso.

"Ob idque ὄργανον τῶν ὄργάνων hoc ipsum rite appellaveris cum Argenterio, ut de manibus dixit Aristoteles. Is autem est calor vitalis, ex corde perpetuo influens, qui singulas partes ad proprium opus agit et excitat."

17. Ulmus: De Liene, page 12, recto.

". . . manifestum inde fit, quod cavitas in liene sit nulla insignis, in qua asseruari possit excrementum illud: quae certe necessaria omnino est in eum usum, quemadmodum videre est in vesica utraque, renibus, glandulis sive vesiculis parastatis, cerebri ventriculis, utero et mammis. In his enim partibus omnibus cavitates insignes sunt . . ."

18. Ulmus: De Liene, page 22, recto.

". . . succus a ventriculo et intestinis per manifestas vias ad lienem attractus . . . et concoqueretur: novaque fieret materia, diversa nimirum ab ea, quae allecta est."

19. Ulmus: De Liene, page 22, recto.

"Similis parque usus apparet in pulmonibus, testibus, vasisque seminariis, plexu choroede, mammis lactantium: in quibus omnibus fabricata est natura similem vasorum implexum, quia novam coquere materiam debebant . . . Non absurdum igitur fuerit . . . si lienem a natura conditum iudicemus, ut sanguinem praecoquat arterialem."

20. Ulmus: De Liene, page 19, verso.

". . . vicem subiit arteria illa insignis, quae a liene prolectum sanguinem tenuem in truncum aortae portat; indeque in sinistrum cordis ventriculum et reliquas totius corporis arterias."

21. Ulmus: De Liene, page 16, recto.

"Spirituosae sanguinis arterialis parti, in ventriculum cordis sinistrum attrahitur; ibique in spiritum vitalem transmutatur, vi cordis innata, praecipueque partis ipsius sinistrae. Haec enim praecipua est spiritus vitalis officina . . ."

22. Ulmus: De Liene, page 19, recto.

"at non suffecit in foetu via haec, per septum scilicet cordis intermedium . . . sed aliam molita est natura etiam, eamque valde manifestam, per quam sanguinem in arterias commode traduceret, arterias nempe duas, quae ab umbilico foetus in crurales eiusdem arterias producuntur . . ."

23. Ulmus: De Liene, page 19, recto.

"Tum enim foetus ipsius cordis ventriculus sinister sanguinem vitalem et spiritum a materno utero alliciebat per arterias illas umbilicales."

24. Ulmus: De Liene, page 19 recto.

"Ergo et in homine grandiore dare debuit natura viam aliquam manifestam, per quam sanguis in arteriam aortam, et sinistrum cordis ventriculum traducatur, cum maior sit in hoc, quam in foetu, sanguinis vitalis necessitas, ob maiorem eiusdem per assiduos corporis et animi labores dissipationem."

25. Ulmus: De Liene, page 19, verso.

"Non etenim prohibebant, dum in utero esset foetus, quominus sanguis cum spiritu vitali ab utero materno prolectus, inde arteriam magnam per umbilicales foetus arterias transmissus, in cordis ventriculum sinistrum introiret. An verius dicemus adiectas esse has membranas, non ut viam ab arteria in cor omnino praeccludant: sed ut sanguinis refluentis impetum duntaxat frangant, quo alioquin calor, qui in sinistro cordis, ventriculo excellere debet, obrui vel etiam suffocari posset: non secus ad ignem luculentum videmus obrui, adeoque interdum extigui multa et conferta lignorum congerie?"

26. Archangelus Piccolomini: Anatomicae Praelectiones
Explicantes Mirificam Corporis Humani Fabricam (Rome
1586, to be referred to as Praelectiones), page 135

"Alterae sunt vene splenicae, quae ab ipso splene diriguntur in os ventriculi, hunc in finem, ut crassior melancholici humoris portio, quae lienis vi, nec molliri, nec subigi, potuit, tanquam ad nutriendum inepta, in os ventriculi proprio ductu, quasi eructando, eiiciatur."

27. Piccolomini: Praelectiones, page 135

"An temere ac fortuito? Haec indomita humoris melancholico portio, cum austera sit et acerba, ventriculum astringit et in angustum adducit, ut inde omnis illius actio, firmior sit et validior. Nec solum os ventriculi, ipsumque totum roborat et firmat, verum est torpentem atque deiectam appetentiam, erigit ac suscitatur ut plerique tradunt . . . Quis igitur summam naturae providentiam non admiretur, quae hoc vilissimum excrementum, in hos praeclarissimos usus accommodaverit."

28. Piccolomini: Praelectiones, page 137

"Quare lien habendus quoque est in numero earum partium, quae ad aliarum, et totius corporis, communitatem comparatae sunt. Nisi enim sanguinem ab hoc crasso, et faecis vinaceae aemulo, excremento repurgaret, partes corporis omnes improbo nutriendum alimento, atque ita brevi hoc excremento onustae, succumberent internitioni. An ergo, quia caeteris partibus puriorem pastionem procurrat, sit rationis particeps, providentiaque id agat? Nequaquam, sed aliud agens, sibi, operam dans, et idoneum sibi alimentum procurrans ex naturali melancholico succo, puriorem sanguinem in nutrimentum aliis procurare videtur. An etiam regatur lien et conditus sit, ab ea natura, a qua omnis ratio, omnisque providentia, proficiscitur? Non agit igitur ex ratione, et praevisione, sed rectus a natura ea, quae summa ratione, summaque, providentia, omnia regit, omnia administrat, ac moderatur."

29. Piccolomini: Praelectiones, page 137

"Alterum quoque lienis usum, quem Aristoteles ut paulo ante recitavi, videtur invexisse, admitti posse opinor, scilicet valere datumque esse ad sanguinis confectionem. Id quod plane intelligetur distinctione isthac praemissa. Aut lien naturali, proprioque colore fulget, praeditus que est, aut colore naturae repugnante. Sin naturali colore, ideoque germana constitutione est praeditus, aut tantam molem obtinet, quantam natura praescripsit, aut longe maiorem ita, ut mole iecur superare videatur, aut duo

tres ve lienes sunt, quot Fallopius in re anatomica dilligentissimus, se aliquando comperisse testatur. His praemissis, dicimus. Si lien naturali colore et constitutione sit praeditus, isque longe insignior et grandior, quam sit ipsum iecur, existimari potest, Aristotelis mentem, esse veram, nempe lienem datum esse; ut iecori opituletur ad sanguinis confectionem praesertim si iecur longe minus sit liene. Quale in nonnullis compertum esse praedicant. Nam parva illa iecoris moles, in sanguine elaborando atque conficiendo, omnibus corporis partibus subvenire nequit, idcirco auxiliarium ei dari, par erat."

30. Piccolomini: Praelectiones, page 134

"Nam lienis color, dum utero gestamur ruber est clarus tanquam hepar, cum vero sumus adulti, est ruber nigrore perfusus . . . Quia lien in foetu, nutritur sanguine puro, et ab humore melancholico tanquam faece repurgato, repurgatur autem ille, a materno liene . . . An vero in nobis adultis, lien tinctus est colore rubro obscuro, et in nigrorem tendente, propterea quod attrahit terrenum melancholicumque sanguinem, quo nutriatur, cuius color, in rubro nigrat."

31. Piccolomini: Praelectiones, page 137

". . . planius intelligetur ex solutione eorum, quae obiici possent. Nam cum Aristoteles 3 de partibus animalium cap. 7 scribit; iecur et lienem ad cibi concoctionem iuvare, propterea quod calidam habeant naturam, Averrhois contrarium sentiens, in paraphrasi de animalibus, haec profert. Lien ex se sanguinem non gignit; Cuius rei signum est, quod una vena a stomacho ad lienem protenditur, qua lien a melancholia expurgatur, non autem chylus attrahitur. Cui responderi potest. Per quam venam lien expurgatur ab humore melancholico . . . per eandem allici chylum a ventriculo in lienem, sicuti per easdem venas mesaraicas, chylus vehitur ab intestinis ad iecur, et sanguis revehitur a iecore ad intestina alenda."

32. See Galen: On the Natural Faculties, book III, chapter XIII, page 293-297 (Loeb edition, 1963)

33. Piccolomini: Praelectiones, page 137

"Cum itaque chylus fuerit in liene, et a liene in sanguinem conversus, tunc a liene per quartum venae portae ramum effenditur in iecur, ut illinc deinde per radices et ramos venae cavae, quoquoersum in omnes corporis partes alendas distribuatur. Neque absurdum putandum, per quartum venae portae ramum, et succum melancholicum naturalem attrahi in lienem; et sanguinem sibi superfluentem, aliene transfundi in iecur, quia diversa harum partium desideria existunt."

34. Piccolomini: Praelectiones, page 137-138

"A iecore quidem melancholicum succum, quem cum iecur devincere et immutare non possit, lien assidua eaque valida arteriarum pulsatione, vincit, exterit, et mutat in sanguinem. A ventriculo autem chylum, quem iisdem viribus in sanguinem convertit. Quapropter duplex erit lienis usus, alter ut repurget sanguinem omnibus partibus distribuendum, a squalido illo et lutulento succo, alter ut iecori opituletur cum id minori fuerit mole ad copiosiore sanguinem conficiendum."

35. Piccolomini: Praelectiones, page 138

36. Piccolomini: Praelectiones, page 138

"Demum quaeri potest, an humor melancholicus feratur, a iecore expulsus, vel a liene attractus? In lienem pervenire existimo, tum a iecore depulsus, tanquam onus inutile sibi; tum a liene attractus, tanquam alimentum sibi familiare. Ita ut amborum nempe expulsionis et attractionis concursione, haec efficiatur transvectio."

37. For an appreciation of Crooke, see O'Malley: "Helkiah Crooke M.D., F.R.C.P., 1576-1648" (Bulletin of the History of Medicine 1968, 42, 1-18)

38. Andreas Laurentius: Historia Anatomica (Frankfurt 1599, to be referred to as Hist. Anat.) page 247

"Quemadmodum agricolae foecundas segetes lupinis circumdat, ut allecto terrae amarore laetius dulciusque evadat triticum: ita ex adverso hepatis lienem construxit Natura, ut expurgato faeculentis sordibus hepate, et crassa ac lutulenta succorum illuvie haustra, purior illustriorque reddatur sanguis."

39. See for instance, how Laurentius inserted a classical tag attributed to Trajan when he wrote that in healthy people the spleen is small but when the body wastes away the spleen grows larger.

Laurentius: Hist. Anat., page 247

". . . quibus corpus floret, lien minuitur, quibus contra lien augescit, corpus minuitur. Unde non inepte Traianus Imperator 'fiscum' lienem appellabat. Quemadmodum enim crescente liene, reliquum extabescit corpus, ita ditescenfisco populus depauperatur."

40. Laurentius: Hist. Anat. page 248

41. Helkiah Crooke: Μικροσκομογραφα. A description of the Body of Man . . . (London, 1615, to be referred to as Micro), page 181

42. Crooke: Micro, page 181
Laurentius did write at some length about the opinion of the author of the Book de Respiratione, and he had obviously taken the trouble to understand it.
43. Crooke: Micro, page 181-182
Laurentius: Hist. Anat. page 248
44. Crooke: Micro, page 182
45. Crooke: Micro, page 182
46. Crooke: Micro, page 182
47. Crooke: Micro, page 182
Laurentius: Hist. Anat. page 248
48. Crooke: Micro, page 182
Laurentius: Hist. Anat. page 248
49. Crooke: Micro, page 182
50. Crooke: Micro, page 183
51. Crooke: Micro, page 183
52. Crooke: Micro, page 183 Nat. Fac.,
For the passage in de Usu Partium see Chapter I, page 17
note 16 of this thesis.
53. Crooke: Micro, page 183
54. Crooke: Micro, page 183-184
"Furthermore, that the spleene is the receptacle of foeculent blood may thus be demonstrated: If the spleen bee obstructed, this muddy blood floweth presently backe unto the Liver, and infecteth that which is pure and laudable with his couler, and hence the habite of the body becommeth melancholy, and the patient overtaken with the blacke Iaundise."
For the argument by Galen, see Chapter I, page 19 of this thesis.
55. Crooke: Micro, page 185 and page 186 respectively.
56. The details of Bauhin's life as well as the comments about the Theatrum Anatomicum are taken from the article on Caspar (Gaspard) Bauhin by Dr. G. Whitteridge in the Dictionary of Scientific Biography.
57. Crooke: Micro, page 126
The chapter on the spleen in Caspar Bauhin's Theatrum Anatomicum (Frankfurt 1605, to be referred to as Theatrum), begins on page 270. The passage translated by Crooke to which this note refers, occurs on page 272-273.

58. Crooke: Micro, page 126
Bauhin: Theatrum, page 273
59. Bauhin: Theatrum, page 275
60. Crooke: Micro, page 127
61. Crooke: Micro, page 127-128
62. Crooke: Micro, page 128
63. Crooke: Micro, page 128
64. See Caspar Hofmann: De Usu Lienis ([Leipzig] 1615), especially Chapters VII-X, where he describes how chyle is conveyed to the spleen and elaborated, and Chapters XIII-XVIII which relate how the excrements of the spleen are evacuated.
65. Crooke: Micro, page 128
Bauhin: Theatrum, page 278
66. Bauhin: Theatrum, page 278
"Quando vero hepate calloso, vel exeso, eoque non sanguificante, lien eius vices obit, portio elaborati sanguinis per ramum Splenicum in hepatis venas transmittitur, et per cavae radices et ramos in partes alendas, non secus quam sanguis is, qui in hepatis venis fuit elaboratus, distribuitur."
67. Crooke: Micro, page 129
68. See Chapter 2, page 58, and note 29 of this thesis, and the whole of the passage on the spleen in Harvey: The Anatomical Lectures (edited G. Whitteridge) page 127-129 where Harvey can be seen to side with the Aristotelians.
69. Crooke: Micro, page 129
70. See, for example, Adrianus Spigelius: De Humani Corporis Fabrica (Frankfurt, 1632), page 280 and 309-313, and Caspar Bartholin: Anatomicae Institutiones ([Wittenberg?] 1611) page 96-106
71. Caspar Hofmann: De Usu Lienis ([Leipzig] 1615)
72. Veslingius: Syntagma Anatomicum (Padua 1647)
"Actionem lienis, ex majore doctorum consensu, constituto confectionem sanguinis, ex aquosione chyli portione, administisque partibus terreis sordida. Quibus autem viis ad officinam illam feratur haec materia, caliginosam veluti nocte natura premit."

Nam lacteos ad lienem ductus nulla hactenus observatio detexit. Per venam etiam splenicam, et ab ea productos ramos nihil ad lienem deferri, abunde vivorum animantium dissectio, atque in iis instituta vasorum ligatura patefecit. Arterias pariter non materiam ex qua sanguis fieri debet; sed eundem optime confectum, spirituque vitali jam perfusum partibus corporis subministrare."

NOTES - CHAPTER IV

1. Plato: Timaeus (translated by B. Jowett in Great Books of the Western World vol. 7, published by Encyclopaedia Britannica Inc., to be referred to as Timaeus (Jowett), p.463
2. Plato: Timaeus (Jowett) p.464
3. Plato: Timaeus (translated by H.D.P. Lee, published by Penguin Books Ltd. 1965; to be referred to as Timaeus (Lee) p.90
4. Plato: Timaeus (Lee) p.91
5. See Plato: Timaeus (Lee) p.60
 "This and similar effects were produced in the soul's orbits, . . . for when the impact of external sensation subdues the orbits and their container, then the orbits only seem to be in control but are in fact overpowered. And because of all this the soul when first bound to its mortal body is as much without reason today as it was in the beginning. But when the stream of growth and nourishment flows less strongly, the soul's orbits take advantage of the calm and as time passes steady down in their proper courses, and the movement of the circles at last regains its correct natural form, and they can name the Different and the Same correctly and render their possessor rational."
6. Aristotle: De Anima, (Loeb edition 1957) p.69
7. Aristotle: De Anima, p.69-71
8. Aristotle: De Anima, p.71
9. Aristotle: De Anima, p.85
 ". . . and if one should have examined, even before these functions, the objects corresponding to them, then for the same reason one must first of all determine the facts about those objects, e.g. about food or the object of perception . . ."
10. Aristotle: De Anima, p.135
 "The tactual organ which perceives them, i.e. that in which the sense of touch, as it is called, primarily resides, is a part which has potentially the qualities of the objects touched. For perception is a form of being acted upon. Hence that which an object makes actually like itself is potentially such already."

11. Aristotle: De Anima, p.137

12. Aristotle: De Sensu (Loeb edition 1957) p.245
See Crooke: Micro, p.632

"The kindes of sapours as the Philosopher sayth, are accounted after the same manner with the kindes of Colours. For as white and black are contraries, and the other colours leane to this or that Contrary: so Sweete and Bitter are the two simple contraries . . ."
This is taken from Bauhin: Theatrum Anatomicum p.985

13. See Galen: Nat. Fac. p.45-47

14. Galen: De Simplicium Medicamentorum ac Facultatis
(Opera Omnia, edited by D.C.G. Kühn, Leipzig 1821-1833
vol. XI) p.639

"Velox siquidem acidorum saporum transitus in sentientibus partibus fieri conspicitur, acerborum autem tardus, tum acida quidem in alto magis agere apparent, in superficie autem acerba. Haec itaque omnia crassarum esse partium acerba indicant, acida vero tenuium. [καὶ τὰ μὲν ὄξέα διὰ βάθους ἐνεργεῖν φαίνεται μᾶλλον, ἐπιπολῆς δὲ τὰ στρωφά. ταῦτ' οὖν ἀπάρτα παχύμερῆ μὲν εἶνα ἐνδείκνυται τὰ στρωφὰ ὥματα, λεπτομερῆ δὲ ὑπάρχουν τὰ ὄξέα.]

15. Galen: De Symptomatum Causis (Kühn vol. VII) p.122

". . . propterea quod substantia est crassiore: at in odoratu adhuc manifestior delectatio, quod ejus substantia sit magis crassa . . . Quum autem odoratus et gustus sensus sint congeneres, sola substantia tenuitate dissidentes (est enim halitus humor attenuatus) . . ."
[ἐνὶ μόνῳ διαφέρουσα τῷ λεπτομερεστέρω τῆς οὐσίας, (ὄχι ἀπὸς ὕγρον ἐστὶ λεπτομερὲς)]

16. Galen: Use of Parts, p.430-433

17. Galen: Use of Parts, p.61

18. Galen: Use of Parts, p.396-7

19. Galen: Use of Parts, p.397

20. Galen: Use of Parts, p.398

21. Galen: Use of Parts, p.446-448

22. See Margaret May's Introductory chapter 'Galen's System of Physiology in Galen: Use of Parts and her comment on p.45

23. See Galen: Nat. Fac. p.25, 45 and 47
24. For an account of some of the disputes concerning the nerves see: Harvey: The Anatomical Lectures, p.331-335
25. That is, devoid of interest in relation to the progress of science. In terms of this thesis the sterility of the work of the anatomists is highly relevant.
26. O'Malley: Vesalius, p.178-180
27. Mondino: Anathomia (Singer) p.91
28. Vesalius: Fabrica (1543) (translated by Charles Singer in Vesalius on the Human Brain, London 1952, p.4) p.623
29. Vesalius: Fabrica (translated by O'Malley: Vesalius, p.178) p.623
30. Vesalius: Fabrica (Singer p.39-40) p.636
31. Vesalius: Fabrica (Singer p.6-7) p.624
32. Vesalius: Fabrica (O'Malley p.180) p.623
33. Crooke: Micro, p.517
Laurentius: Historia Anatomica, p.401
34. Crooke: Micro, p.472
Bauhin: Theatrum Anatomicum, p.610-611
35. The text of the passage from Laurentius is as follow:

"Hic porro spiritus, motus sensusque et principum facultatum immediatum organum specie quidem unicus est, obiectorum tamen et organorum varietate multiplex existimatur; quod docuit eleganter Aristoteles quinto De generatione animalium, cap. ult. Sic se habet (ait) spiritus in rebus a natura institutis ut malleus in arte fabrili unum scilicet instrumentum ad plures actiones est utile. Actuarius radorum solarium exemplum affert, qui licet sint uniusmodi, dissimiles tamen et variegati redduntur pro varietate colorum."

The text of the passage from Bauhin reads as follows:
 "Idem ^uantem est spiritus animalis et specie unicus . . . idque pro instrumentorum varietate, in quae a cerebro effusus, incurrit: quare si ad oculos feratur, qui instrumentum visus sunt, visus fit: si ad aures, auditus etc. quod Aristoteles eleganter demonstravit exemplo mallei: sic se habet (ait) spiritus in rebus a Natura institutis, ut malleus in arte fabrili, unum scilicet instrumentum, quod ad plures actiones utile est, et Actuarius radorum solarium exemplo declarat: hi licet uniusmodi sint dissimiles tamen et variegati pro colorum varietate redduntur."

36. Crooke: Micro, p.473
 Bauhin: Theatrum Anatomicum, p.613
37. See below p.148 of this chapter
38. Crooke: Micro, p.518
39. Harvey: The Anatomical Lectures, p.329
40. O'Malley: Vesalius, p.179
41. See chapter 7 and note 67 of this thesis
42. Vesalius: Fabrica (O'Malley, p.179-180) p.642
43. Vesalius: Fabrica (Singer, p.58) p.642
44. Vesalius: Fabrica (Singer, p.3) p.622-623
45. Realdo Colombo: De Re Anatomica (Venice 1559) p.191
 "Per hos superiores cerebri ventriculos feruntur plexus coriformes, quos reticulares appellavimus. Usus autem horum est animalium spirituum generatio. Atque hoc quod nunc dicam, quoniam meum inventum est; obsecro, diligenter attende."
46. Colombo: De Re Anatomica, p.191
 ". . . aer autem per nares attractus in frontis, . . . alteratus de inde ad hos binos ventriculos, quos ego superiores appellavi perforamina ithmoidis ascendit, at in his ventriculis ob assiduam tum cerebri, tum huius reticularis plexus motum miscetur cum vitalibus spiritibus aer: itaque spiritus animales evadunt ex aere eo, quo diximus modo praeparato, et ex vitalibus dictis spiritibus quae res a nemine ante me observata fuit."
47. Piccolomini: Praelectiones, p.253
 ". . . spiritus animalis, quem in admirabili contextu inchoatum, summo caractere, omnibusque suis partibus ornat et perficit, in contextibus choroidibus. Unde constat, eos aberrare, qui scibunt, spiritum animale fieri in ventriculis. Non enim ventriculi sunt spiritus animalis effectores, sed sunt conservatores illius . . . A ventriculis, et cavitatibus nulla vis pendet, illum perficiendi, sed omnis a cerebro eiusque medulla."
48. Piccolomini: Praelectiones, p.253
 "Ut in iecore vis ingenita inest, spiritum naturalem conficiendi, quem in radicibus venae tum portae tum cavae perficit, et in corde vis innata insidet, spiritum vitalem conficiendi, quem tamen in sinu suo sinistro

absoluit, ita cerebrum eiusque medulla est opifex
et affectu spiritus animalis."

49. Laurentius: Historia Anatomica, p.390

"Ad praeparationem spirituum plexus constructi sunt
. . . Plexus in superioribus ventriculis siti, Graecis
πλεγματα η βιβρεμματα χοροειδων
nominantur. Sunt venularum et arteriolarum textus
labyrinthi . . ."

50. Laurentius: Historia Anatomica, p.391

"ad latera ^autem apophyseion choroidum plexus apparet,
quem . . . rete mirabile, vocat Galenus. Ego malim
cum neotericis choroidem plexum, qui in superioribus
ventriculis cernitur rete mirabile appellare."

51. Crooke: Micro, p.516

52. Crooke: Micro, p.470

Bauhin: Theatrum Anatomicum, p.609

53. Harvey: The Anatomical Lectures, p.335-337

NOTES - CHAPTER V

1. A. Castiglioni: A History of Medicine (New York, 1946) p.536-537
2. Castiglioni: A History of Medicine, p.537
3. Sanctorius Sanctorius: Commentaria in Primam Fen Primi Libri Canonis Avicennae (Venice 1626, to be referred to as Comm Fen Avic) p.21
 Quaest. VI 'Qua ratione ars medica sit coniecturalis'
 "Ars medica est coniecturalis ratione quantitatis morborum, remediorum, virtutis, ratione idiosyncrisiae."
4. Sanctorius: Comm Fen Avic, p.21
 "Ratione quantitatis morborum: Galenus enim 9 Meth. 15 dicit, ut verum exhibeatur remedium, non solum oportet cognoscere morbi speciem, sed etiam eius quantitatem quae ex Gal. 9 Meth. 14 est certa mensura quantitatis recessus a naturali statu quae quantitas solum coniectura haberi potest."
5. Sanctorius: Comm Fen Avic, p.21
 "Nos diu cogitavimus quomodo illud quantum morborum aliqua ex parte aliquando cognosci possit. Excogitavimus quatuor instrumenta."
6. Sanctorius: Comm Fen Avic, p.21
 "Primum est nostrum pulsilogium, quo per certitudinem mathematicam, et non per coniecturam dimetiri possumus ul^{ti}mos gradus recessus pulsus quo ad frequentiam, et raritatem."
7. Sanctorius: Comm Fen Avic, p.22
 "Per tale instrumentum tempore sanitatis pulsus dimetitur: deinde tempore aegritudinis animadvertimus recessum a naturali statu . . . Ad haec cognoscimus differentiam inter pulsum humile, et invalidum in qua re saepe medici decipiuntur, dum confundunt pulsum humilem cum invalido: differentia est, quia invalidus in febribus non remittit frequentiam; humilis vero remittit, quae remissio, si exigua sit, a medicis sine instrumento non percipitur et in praedicendo turpiter hallucinantur."
8. Sanctorius: Comm Fen Avic, p.22-23
 "2 figura est vas vitreum quo facillime possumus singulis horis dimetiri temperaturam frigidam, vel calidam, et perfecte scire singulis horis quantum temperatura recedat a naturali statu prius mensurato."

Quod vas ab Herone in alium usu proponitur. Nos vero illud accomodavimus, et pro dignoscenda temperatura calida et frigida aeris et omnium partium corporis, et pro dignoscendo gradu caloris febricitantium."

9. Sanctorius: Comm Fen Avic, p.24

". . . colligemus, an aeger in melius vel in peius labatur, quae differentiae si exiguae sint a medicis sine instrumento minime percipi possunt, et inde in cognitione, praedictione, et curatione hallucinantur . . ."

10. Sanctorius: Comm Fen Avic, p.24

". . . Quanti vero momenti sit haec observatio sciunt aegrotantes qui humido et qui sicco morbo fuerunt oppressi, quos ope istorum instrumentorum ad sanitatem perduximus."

11. Sanctorius: Comm Fen Avic, p.24

"Quarto nos praeterea cogitavimus, quomodo, ex staticis experimentis mensuram certam perspirationis impeditae certissime colligere possumus: quae experimenta per aphorismos digesta in lucem edidimus."

12. Sanctorius: Comm Fen Avic, p.24

"Ratione quantitatis remediorum medicina est coniecturalis, ut docet Galen lib. de curandi ratione per sanguinis missionem cap 12 ubi habet, remedii quantitatem facere artem coniecturalem . . . Similiter Galenus 3 Simpl. 12, ait, si remedium fuerit minus, non sanabit, iuvabit tamen, si maius, introducet contrarium morbum: quare est admodum difficile invenire remedium omnino aequale: dicit aequale: quia medicus non vult vincere, sed moderari et attemperari, utinam medici munus esset vincere, medicina sane esset valde facilis."

13. When Sanctorius gave Galen's reasons for the conjectural nature of medicine, he repeated Galen's statement that if the heat of an illness was two in degree it would need a remedy that would cure by a factor of two. Sanctorius's instruments would have helped towards this aim:-

Sanctorius: Comm Fen Avic, p.24

". . . remedii quantitatem facere artem coniecturalem: ratio desumitur quoque a Galeno in tertia parte artis medicinalis, ubi inquit, morbum calidum ut duo indicare remedium remedium ut duo. Similiter Galenus 3 Simpl. 12, ait . . ."

It can be clearly seen from this passage and the one in note 12 above that Sanctorius accepted the validity of Galen's doctrine of cure by contrary qualities.

14. Sanctorius: Medicina Statica: Or Rules of Health . . . English'd by J.D. (John Davies), (1676, London).
Signature A.3. recto.
15. For a translation of the De Staticis Experimentis of Nicholas of Cusa see Henry Viets: "De Staticis Experimentis of Nicholas Cusanus" in Annals of Medical History 1922. 4. pp.115-135
16. Sanctorius: Medicina Statica (John Davies), Signature A.5. recto and verso.
17. Sanctorius: Medicina Statica . . . translated by John Quincy (2nd edition London 1720, to be referred to as Statica (Quincy)) Aphorism 1. section 1 p.43
18. Sanctorius: Statica (Quincy), Aphr. II Sect. I p.44
19. Sanctorius: Statica (Quincy), Aphr. IV Sect. I p.44
20. Sanctorius: Statica (Quincy). Aphr. V Sect. I p.45
21. Sanctorius: Statica (Quincy), Aphr. VI Sect. I p.47
22. Sanctorius: Statica (Quincy), Aphr. VII Sect. I p.47-48
23. Sanctorius: Statica (Quincy), Aphr. IX Sect. II p.137-138
24. Sanctorius: Statica (Quincy), Aphr. X Sect. VI p.277
25. Sanctorius: Statica (Quincy), Introduction, p.3
26. Sanctorius: Medicina Statica (translated by John Davies) Sect. VIII 'To the Staticomastix' Aphr. XII p.177. I have been unable to find the date of the first publication of Staticomastix. The reply of Sanctorius was published as the eighth section of the Statica.
27. Sanctorius: Statica (Quincy), Aphr. XX Sect. I p.53
28. Sanctorius: Statica (Quincy), Introduction, p.2-3
29. Sanctorius: Statica (Quincy), Preface, p.IV-V
30. Sanctorius: Medicina Statica (translated by John Davies) Signature A.3 recto and verso.
31. Sanctorius: Methodi Vitandorum Errorum Omnium, qui in Arte Medica Contingunt (Venice 1603, to be referred to as Meth. Errorum) p.188 recto.

"Ostenditur ex analyticis principiis, quod experientia sit fallax et periculosa."

32. Hippocrates (Adams): Aphorisms, Section I Aphorism 1, p.131

"Life is short, and Art long; the crisis fleeting; experience perilous and decision difficult.

33. Sanctorius: Meth. Errorum, p.188 recto

"Iam patet ex Hippocrate et Galeno, quod omne experimentum sit fallax et periculosum, nunc altioribus principiis ostendemus experimenti fallacias."

34. Sanctorius: Meth. Errorum, p.188 recto

". . . omne experimentum acquiritur per inductionem, vel exemplum; at sic est, quod inductio et exemplum reducuntur ad falsum syllogismum, ergo experimentum erit fallax."

35. Sanctorius: Meth. Errorum, p.188 verso

"Amplius, quando experimentum colligetur a particularibus, non concludet, quia ex puris particularibus nihil sequitur. Neque obicias, quod experientia non ex duobus particularibus, sed a pluribus colligitur; quia respondemus, quod si ex mille eam colligeres, non posses universalem conclusionem inferre; quinimmo si per milliona millia induceres adhuc non posses conclusionem universalem haurire; quoniam quaelibet species universalis sub se continet infinita particularia."

36. Sanctorius: Meth. Errorum, p.188 verso

". . . dato adhuc quod per infinita particularia induceres, tibi adhuc esset videndum, an semper omnibus attributum conveniat: quod est omnino impossibile, ut mortalis homo per experientiam consequatur."

37. Sanctorius: Meth. Errorum, p.188 verso

". . . experimentum cum fiat procedendo a singulari ad singulare, nihil concludere potest."

38. Sanctorius: Meth. Errorum, p.189 recto

"Sed magna exurgit dubitatio, quia est Aristotelis auctoritas . . . Cum unum particulare in memoria steterit, tunc primum incipit in anima esse universale: sed sic est, quod particularia virtute inductionis, vel experientiae conservantur in memoria, ergo inductio, vel experientia pariet universale. Praeterea experimenta videntur parere cognitionem causarum et demonstrationem quia, at sic est, quod causarum cognitio est universalis, ergo experimenta indicabunt universale; maior pluribus exemplis confirmatur, sed duo omnium vice afferri possunt; suntque, quia non videtur, alio modo addisci posse haec universalia, quod guaiacum sit causa curationis gallicae luis, et rhabarbarum bilis."

39. Sanctorius: Meth. Errorum, p.189 recto

"Dum particulare est in memoria, incipiat esse universale in anima quia in quolibet particulari est inclusa tota natura universalis . . . Intellectus separat universale a singularibus suo proprio lumine."

40. See Chapter VI note 14

41. Sanctorius: Meth. Errorum, p.189 recto

"Aristotelis 2 post., in fine libri dicit intellectum separare hominem a Callia homine; quia in Callia est inclusa tota humana species."

42. Sanctorius: Meth. Errorum, p.189 verso

"respondemus primo, quod ab experientia nemo unquam colliget propositiones universales sed solam indefinitas haec propositio guaiacum curat gallicum est indefinita et non universalis . . . aliqua lues gallica, quae guaiaco non curabitur et aliquod guaiacum quod nullam gallicam luem curare possit."

43. Sanctorius: Meth. Errorum, p.189 verso

"Secundo, dum dicunt experientiam, quoniam procedit ab effectibus ad causas, esse demonstrationem a posteriori de ratione cuius est, ut pariat universale. Respondemus, experientiam non procedere ab effectibus ad causas, sed ab effectibus ad subiecta particularia et indefinita."

44. Sanctorius: Meth. Errorum, p.189 verso 190 recto

"Non tamen negamus inductionem, vel experimenta conferre posse ad cognoscendum universale; quia, ut dicit Boetius in praedicamentis, experientia est exemplorum collectio, postquam collectionem intellectus a proprio lumine excitatur ad separandam naturam universalem ab individuali; tota enim natura universalis est in quolibet individuo."

45. Sanctorius: Meth. Errorum, p.190 recto

"Averroes 2 priorum 29 habet, inductionem inseruire cognitioni universalis ex accidente, quatenus scilicet ob multorum exemplorum collectionem frequentius offertur intellectui obiectum universale, quod in quolibet particulari est inclusum."

46. Sanctorius: Meth. Errorum, p.1 recto

"Constare arbitror in arte Medica curatrice, infinitos committi errores posse vel in cognitione morbi; vel causae, vel in auxiliorum inventionem, vel in praesagiendo, vel postremo in remediorum administratione."

47. See Sanctorius: Meth. Errorum, p.8 verso
Book I chapter IX entitled, "Methodus de syndrome
signorum affectuum a sex fontibus tantum colligenda."
48. I have appended on pages 352-358 of this thesis the
chapter 'On the supreme division of all illnesses' and
given a translation of the tables contained in the
chapter. I have also appended the first page of the
chapter on the relation of flavours to humours on
page 100 verso of the Meth. Errorum together with a
translation of the table. From the tables it can be
easily seen how Sanctorius related signs to categories
and how categories were the foundation stones of his
system.
49. Sanctorius: Meth. Errorum, p.100 verso
"quod omnia signa propria peccantium humorum
reduci videntur ad tria capita . . ."

NOTES - CHAPTER VI

1. To be referred to as Ren. Con. of Meth.
2. See Gilbert: Ren. Con. of Meth. p.49
3. Vesalius: Epitome (Basle 1543) in the Dedication to Charles V he wrote of compediums: ". . . rerum cognitionem viam quandam et rationem praefigere videantur . . ."
4. Plato: Phaedrus (translated by B. Jowett in Vol. III of The Dialogues of Plato, (New York [1912]) p.430-431
5. Plato: Phaedrus, p.433
6. Plato: Phaedrus, p.434-435
7. Plato: Phaedrus, p.435
8. Plato: Phaedrus, p.435-436
9. Plato: Phaedrus, p.436
10. Plato: Phaedrus, p.436-437
11. Aristotle: Physics (Loeb edition 1963), Book I, chapter 1, p.11
12. J.H. Randall Jr: The School of Padua . . . See, for example p.64-65 where Randall discusses Zabarella's achievement and writes: "And so he counseled ever closer attention to the way of discovery, to the careful and painstaking analysis of experience, to the method of resolution, within which he included as phrases both induction and demonstration a posteriori.
 "There was but one element lacking in Zabarella's formulation of method: he did not insist that the principles of natural science be mathematical."
13. Aristotle: Physics, Book I, Chapter 1, p.13
14. Aristotle: Posterior Analytics (Loeb edition 1950) see p.37-39. "The knowledge of immediate premisses is not by demonstration" but ". . . there is a definite first principle of knowledge by which we recognize ultimate truths" (i.e. 'αὐτῶς')
15. Aristotle: Parts of Animals (Loeb edition 1961) Book I, chapter 1, p.53

16. Aristotle: Parts of Animals, Book I, chapter 1, p.53-55
17. Aristotle: Parts of Animals, Book I, chapter 1, p.57
18. Aristotle: Parts of Animals, Book I, chapter 1, p.59-61
19. Aristotle: Parts of Animals, Book I, chapter 1, p.57
20. See Gilbert: Ren. Con. of Meth., p.11-12
21. See Gilbert: Ren. Con. of Meth., p.11-12 and p.11 note 8
22. See Gilbert: Ren. Con. of Meth., p.55
23. Quoted by W.S. Howell: Logic and Rhetoric in England 1500-1700 (New York, 1961) p.201
24. Galen: Galen's Art of Physick, translated by Nicholas Culpeper (London 1652), Proemium, chapter I, p.1
25. Galen: Art of Physick, chapter II, p.2-3
26. Galen: Art of Physick, chapter II, p.3
27. Galen: Art of Physick, chapter III, p.5
28. Galen: Art of Physick, chapter IV, p.5
29. Galen: Art of Physick, chapter XI, p.15
30. Galen: Art of Physick, chapter II, p.3 The square bracketting of 'in respect of time' is Culpeper's.
31. Leonicensis: Nicolai Leonicensi Vicentini De Tribus Doctrinis Ordinatis . . . (to be referred to as De Tri Doc Ord.) in Opuscula (Basle 1532) p.62

"Inter caeteras quaestiones quae agitari solent in Artis parvae Galeni expositione, illa quae est de tribus doctrinis ordinatis, quas Galenus in eius libri proemio statim nominat, difficilima habent: Sed praecipue de duabus altera quae resolutiva, altera quae compositiva nominatur. Nam de tertia quae definitiva dicitur, non adverti Latinos Galeni expositores esse admodum differentes. In duabus vero quas diximus, ita invicem adversantur, ut alii asserant doctrinam resolutivam esse demonstrationem quam ob rem sive propter quid, compositivam vero demonstrationem ut sit, sive quia sit . . . Alii contraria disserant, resolutivam doctrinam ex posterioribus ad priora procedere: compositivam vero vice versa ex prioribus posteriora demonstrare. Primae assertionis autor et princeps fuit Drusianus, cognomento Plusquam commentator. Secundae, Petrus Aponensis dictus Conciliator."

32. Leonicensis: De Tri. Doc. Ord., p.62

"Quocirco factum est, ut in tanta hominum magnae aevi nostro auctoritatis discordia, nondum satis Galeni de hisce doctrinis exploratus sit intellectus: quem nos volentes hoc opere declarare necessarium habemus prius quid antiqui philosophi de doctrinis principalibus senserint, quot ex quales existant, explicare."

33. Leonicensis: De Tri. Doc. Ord., p.62

"Hammonius philosophus apud Graecos gravissimus, in his quae praefatur ad libri Porphyrii de quinque vocibus expositionem, ita de quatuor doctrinis scribit. Quatuor sunt modi doctrinales divisivus, definitivus demonstrativus, et resolutivus. Dicentur autem doctrinales, quia unusquisque aliquid docens, utitur eorum aliquo: veluti si ostensurus sim quod animal est genus, utor divisivo, et dico: Quoniam dicimus genus esse quod dividitur in multas species, hominem scilicet, capram et bovem, igitur animal est genus. Si autem hominis naturam ostendere volo, utor definitio. Ita enim dico: Homo est animal rationale, intellectus et disciplinae capax. Si, autem velim ostendere propter quid homo est animal, utor demonstrativo, atque ita ratiocinor: Homo est rationalis, omne rationale est animal, omnis igitur homo est animal. Si autem velim ostendere hominem esse compositum, utor resolutivo et dico: Homo componitur ex anima et corpore, corpus quoddam totum est, omnis totalitas ex aliquibus partibus constat, corpus igitur immediate componitur ex partibus organicis: Organicae autem partes sunt caput, pedes, et reliqua . . ."

34. Leonicensis: De Tri. Doc. Ord., p.62-62 verso

"Idem Hammonius in commentariis in priores resolutorios Aristotelis ita scribit: Quatuor sunt methodi Dialectices, quae sunt quaedam facultates et veluti germina eiusdem, divisiva, definitiva, demonstrativa et resolutiva et tribus methodis prioribus opponitur resolutiva. Percurramus autem singulas, ut quemadmodum eis opponitur, perdiscamus. Divisiva quidem unum in multa dividit. Definitiva autem plura quae uni rei insunt colligens in unum, eandem rem ab aliis separat atque distinguit. Demonstrativa vero aliud alii in esse demonstrat. Resolutiva vero a compositis ad simplicia regreditur: Et resolutivam quidem opponi divisivae nemo dubitat. Haec enim unum in multa partitur, resolutiva autem multa in unum cogit. Opponitur autem et definitivae: haec enim ex pluribus quae alicui insunt, veluti ex genere et differentiis unam compositam perficit definitionem: Resolutiva vero compositum in simplicia resoluit: considerat enim et genus et differentias ex quibus est constitutum. Opponitur autem et demonstrativae: haec enim aliud alii coniungit,

veluti animae inesse immortalitatem composito syllogismo syllogistice ostendit: resolutive autem eundem disiungit. Ut autem summam dicatur, divisiva quidem genera secat in species: resolutive vero species in genera colligit. Rursus definitiva ex partibus totum aliquod constituit: resolutive autem a toto ad partes transcendit ex quibus componitur totum. Rursus demonstrativa ex causis causata demonstrat: resolutive autem a causati ad causam ascendit: omnibus igitur opponitur resolutive."

35. Leonicensis: De Tri. Doc. Ord., p.73-73 verso

"Quod autem tres doctrinae ordinatae non sint docendi modi, tali argumento colligitur. Doctrinae ordinariae sive ordines doctrinarum secundum Galenum sunt tantum tres. Modi autem doctrinales iuxta antiquos philosophos sunt plures quam tres, ad minimum quatuor. Ergo modi doctrinales non sunt doctrinae ordinatae, de quibus Galenus loquitur. Ordines autem sub quibus, unaquaqueque scientia doceri potest, esse tantummodo tres ita probatur: Scientia quae docetur, aut eodem ordine docetur quo invenitur, et primum in mente constituitur, et hic ordo docendi vocatur resolutorius: vel ordine converso, et hic ordo vocatur compositorius: Ut si quis volens docere artem constituendae domus, primum doceret qua forma, et qua materia tectum sit construendum: secundo loco quomodo parietes sint erigendi, tertio loco ut sint iacienda fundamenta, ultimo loco qualiter terra excavanda: Hic ordinem docendi servaret resolutorium qui a notione finis incipit. Tegumentum enim et defensaculum a frigidibus et imbribus est finis, quem sibi proponit qui domum vult construere."

36. Leonicensis: De Tri. Doc. Ord., p.73 verso

"Si vero contrarium servaret ordinem, et primum doceret quomodo terra effodienda, secundo loco ut iacienda fundamenta, tertio quomodo parietes attolendi, ultimo loco qua forma, et qua materia tectum sit fabricandum: talis ordo diceretur compositorius, qui ordo congruit ordini quo fit domus: sicut primus resolutorius est idem cum ordine quo ratio faciendae domus invenitur."

37. Leonicensis: De Tri. Doc. Ord., p.73 verso

"Si quis vero definiat scientiam quam intendit docere, et in docendo sequatur ordinem partium definitionis, his doctrinam facit definitivam, quam se facturum promittit Galenus in proemio Artis parvae."

38. Leonicensis: De Tri. Doc. Ord., p.81

"Plato vero hanc eandem methodum divisionis adeo extollit atque admiratur, ut in dialogo qui inscribitur Phaedrus, dicat ex persona Socratis, se hominis qui dividendi artem recte pertractet, a tergo tanquam dei vestigia respicere . . ."

. . . quae tamen tanto dignior est doctrina demonstrativa, quanto cognitio principiorum certior est cognitione conclusionum: quanto etiam est illa doctrina praestantior quae rei essentiam explicat, quam quae accidentia substantiae cuiusdam inesse demonstrat."

39. Leonicensis: De Tri. Doc. Ord., p.81

"Quae facultas si vana foret, nullus esset actus sapientiae, in quo ultimum finem hominis ille philosophus collocavit atque ita ad incertum vita humana laboraret."

40. Leonicensis: De Tri. Doc. Ord., p.81

"Nam si doctrina divisiva non sit vera doctrina, non erit neque definitiva: et si definitiva non sit, non erit neque demonstrativa definitio: . . . Ad definitionem autem inveniendam divisio est necessaria."

41. Leonicensis: De Tri. Doc. Ord., p.81 verso

"Nam prima expositio Plusquam Commentatoris verborum illorum Galeni: Tres sunt omnes doctrinae ordinem habentes. Prima ex notione finis quae per resolutionem fit, omnino est dissona graecae literaturae, secundum quam illud relativum Quam, non potest referre notionem finis, sed doctrinam tantum: Et ut etiam antea ex Simplicii atque ipsius Galeni autoritate fuit declaratum, notio finis non fit ex resolutione, sed antecedit resolutionem. Ait Galenus in prooemio dicto, neminem ante ipsum scripsisse doctrinam ex notione finis incipientem, ex qua omnes artes consistunt secundum rationem, ut habet antiqua translatio . . .!"

42. Leonicensis: De Tri. Doc. Ord., p.82 verso

"In quo libro Galenus per eadem fere verba eandem scribit sententiam ex veterum philosophorum autoritate, quod videlicet unicuique arti a notione finis sua sit constitutio, et per notionem finis neque causam remotam, neque effectum postremum intelligit, sed finem artis mente conceptum, ut supra declaravimus."

43. Leonicensis: De Tri. Doc. Ord., p.69 verso

NOTES - CHAPTER VII

1. A. Castiglioni: A History of Medicine (New York 1946) p.442
2. O'Malley: Vesalius, p.75
3. Wightman: "Quid Sit Methodus" (Journal for the History of Medicine 1964, Vol. XIX) p.360-376
4. J.B. Montanus: Methodus Medicinae Universalis (to be referred to as Meth. Med. Univ.) In Medicina Universa (Frankfort, 1587) p.9

"Constitui omnia medicinae fundamenta per methodum inventa dividendo ac resolvendo ante oculos ponere, ut particularia universalibus (in quo finis et artis perfectio est) possimus applicare."

5. J.B. Montanus: In Artem Parvam Galeni Explanaciones (Venice, 1554, to be referred to as In Artem Parvam) p.41 verso

". . . debetis etiam notare unim aliud in methodo nostra data anno elapso, in qua de uno retracto, et non est malum aliquando retractare errato: nam non adhuc videram, quae hoc anno dixi. Dicebam enim anno elapso in methodo illa universali, quod erat quaedam via compositiva separata et distincta a via resolutiva, de qua retracto."

6. W.P.D. Wightman: "Quid Sit Methodus", p.373
7. Montanus: Meth. Med. Univ. p.9, p.10, p.11
The Latin headings of the first three chapters are, 'Quid sit Methodus', 'Qualis sit Medicinae methodus' and 'Sine methodo artem medicam a nemine recte disci posse'.
8. Montanus: Meth. Med. Univ. p.9-10

"Methodus, quo ad nomen nihil aliud est, proprie loquendo et secundum eius proprium significatum, caeteris omissis quae analogice dicuntur, quam brevissima via et calles quidam brevissimi . . ."

9. Montanus: Meth. Med. Univ. p.10

"Ad scientias quoque et ad artes per Metaphoram transfertur, ubi imaginamur brevissimum iter ad finem artis assequendum."

10. Montanus: Meth. Med. Univ. p.10

". . . ut Iohannes Grammaticus definivit, in proemio physicorum, methodus nihil aliud est, nisi habitus rationalis ad aliquem finem. Primum dicit, Est habitus, ut discamus, quod non sufficiat methodum addiscere et audire, sed requiritur ut habeamus habitum, quae est fixa quaedam dispositio in animo ex multis frequentatis actionibus sive actibus."

11. Montanus: Meth. Med. Univ. p.10

"Tendit autem ad omnes, sive sit circa necessaria, ut scientia et sapientia, sive circa contingentia ut ars et prudentia."

12. Montanus: Meth. Med. Univ. p.10

"Si artem constituere debeo, non possum sine methodo. Ideo oportet accedere ad methodum, et tunc methodus finis est. Cum vero accedimus ad corpus humanum et ad opus, tunc methodus principium est; Ideo methodus et finis et principium est. Finis quidem in inventione et resolutione. Principium vero in compositione, quia inveniendi ab humano corpori ad finem tendimus, in compositione vero incipimus a methodo ad artem, ab arte ad sanitatem consequendam in corpore humano et tum cessat ars nostra."

13. Montanus: Meth. Med. Univ. p.11

"Primum per rationes ex fundamento Aristotelis VI Ethicorum ubi ait. Quicumque habitus continet veritatem affirmando, vel negando, ille vel circa necessaria, vel contingentia versatur. Si circa necessaria, erit vel scientia, vel intellectus principiorum, vel sapientia. Si circa contingentia, prudentia, vel ars . . . Sed methodus illa quae medicina dicitur et versatur circa sanitatem, non est circa necessaria, et versatur circa sanitatem, non circa necessariis. Ergo erit vel prudentia, vel ars. Prudentia non est, quia versatur circa ea, quae agit, nec opus relinquit, medicina autem opus relinquit. Ergo medicina est ars."

14. Montanus: Meth. Med. Univ. p.11

"Concludo ergo quod non potest medicina acquiri sine ista methodo. Quod autem omnes artes per veram unam rationem acquirantur, declaratum fuit. Habetis praeterea auctoritatem Arist. 7. Metaphys. et 6. Ethic. ubi ait, artes ratione et methodo acquiri, et docet Aristoteles methodum resolutivam facere ad acquirendam sanitatem, quam Galenus docet. Praeterea videtis Galenum in Philebo dicere, Nullam artem sine methodo divisiva et resolutiva acquiri posse. Qui enim, inquit, artem se acquisivisse sine methodo arbitratur, sciat se umbram artis non artem habere."

15. Montanus: Meth. Med. Univ. p.12

". . . scire et speculari est finis scientiae, et ad universalia terminantur. Ars vero et prudentia circa actiones versantur, et circa particularia. Ideo demonstrationis via non convenit eris, quia demonstratio ex necessariis est, concluditque necessaria, maxime igitur in scientiis requiritur."

16. Montanus: Meth. Med. Univ. p.13

"Vel enim continuum dividimus in partes proportionales, aut quantitativas, et haec est proprie divisio. Reliqua per metaphoram ab hac transferuntur, ut inquit Galenus in fine libri De Placitis Hipp. et Galeni. Prima divisio est continui in suas partes quantitativas vel proportionales. Secunda est generis in species, ut cum animal in suas species dividitur. Tertia est vocis in sua significata, ut cum hoc nomen canis, in coeleste, marinum et terrestre dividimus. Alia est compositi in sua componentia, sicut cum dividimus corpus humanum in partes heterogeneas et similes. Quarta divisio est in potentiam et actum, ut cum corpus simplex in materiam et formam dividimus . . . Quinta cum subiectum in sua accidentia ut cum homines nigros dicimus. Divisio autem artificialis qua medici utuntur, est totius in partes suas formales."

17. Montanus: Meth. Med. Univ. p.13

"Sive enim multiplex dividatur, sive continuum, cum in infinitum dividi possit, non est artificiosa divisio. Et si divisio non habet numerum partium dividendum in determinatum, peccat, et ideo hanc quam artificiosam dicimus."

18. Montanus: Meth. Med. Univ. p.13

"Ubi progressus ab universalibus incipit, et ad minus universale descendit, et rursus a minus universali in partes adhuc minus universales, quousque ad particulares venit fuerit, et tandem ad individuas, ut amplius fieri divisio non possit. Haec Aristotelis divisio est, qua omnes artes et scientiae constituuntur, et maxime medicina circa hanc dividendi artem versatur, et est ea, qua uti debetis in colloquiis ad praesagiendum, et ad recte curandum."

19. Montanus: Meth. Med. Univ. p.13

"Tanta igitur est eius efficacia, ut ex recta divisione emergant omnes artes et scientiae. Ideo non immerito Plato hanc appellat ornamentum Philosophiae, et in Philebo dicebat, divisionem non hominem, sed Deum aliquem invenisse. Et si Deus non fuit, saltem homo Deo proximus."

20. Montanus: Meth. Med. Univ. p.14

"dico quod utilitas divisionis est omnium maxima: quoniam invenitur definitio ex divisione . . . Definitio autem est medium in demonstratione: ergo non potest demonstratio sine divisione constare."

21. Montanus: Meth. Med. Univ. p.14-15

"Via est methodus quaedam procedendi a supremis ad infima, et contra ab infinis ad suprema, ut cum volumus scire totam essentiam substantiae, a prima incipimus, et ad ultimam tendimus, et sic facimus. Primo dicimus, substantiam esse, quae omnibus substemitur. Habita hac descriptione, statim dicimus, substantiarum alia simplex, alia composita, et necessario divisione utimur: vel dicimus: Quaedam corporea est, quaedam incorporea. Volo scire naturam substantiarum, quae sunt corporeae. Posita hac divisione, et quod substantia corporea sit, quae ex omnibus dimensionibus constet, et in qua tres dimensiones reperiantur, dico: Huius substantiae corporeae quaedam simplex, quaedam composita est. Simplex, quae ex partibus constat, quae non per se existunt, ut elementum. Composita autem, quae constat ex materia et forma, quarum partes per se existunt, et tandem devenimus usque ad species, et per viam divisionis invenimus ultimam definitionem, quae dicit, homo est animal rationale, et ita estis in ultima specie."

22. Montanus: Meth. Med. Univ. p.14

"Praeteria quis resolvat, aut componat sine hac arte dividendi? Resolutio enim et compositio sunt propagationes divisionis, immo tota Dialectica ars, et omnia instrumenta ad veritatem indagandam a divisione oriuntur . . . Usus divisionis maxime facit ad omnes artes, et actiones, quae circa particularia versantur. Nam qui vult circa particularia agere, necesse est ut habeat ipsam divisionem pro instrumento."

23. Montanus: Meth. Med. Univ. p.15

"Resolutiva autem doctrina pulchrior est, quae semper ante se habet divisivam, propter similitudinem quam habent. Nam utraque versatur in progressu inter universalis et particularia, et discurrunt ab universalibus ad particularia, et e contrario."

24. Montanus: Meth. Med. Univ. p.15

"Differunt autem quo ad progressum, et quo ad rationem, licet quo ad subiectum idem sint. Divisiva enim non desinit, quo usque ad particularia deveniat."

25. Montanus: Meth. Med. Univ. p.15

"Resolutiva ab uno particulari composito incipit, et illud resoluit in suas causas, et illas accipit, et quaerit adhuc causam causae, et tertio idem facit, et causas illarum quaerit: et iterum quarto ac quinto, neque unquam restat, quousque ad primam deveniat causam, quam cum invenerit, sistit et contemplatur rem quam invenit. Hac utuntur medici et artifices omnes, et ita procedit."

26. Montanus: Meth. Med. Univ. p.15

"Volumus habere sanitatem? Utique. Resoluamus eam in sua principia. Quae vero sunt sanitatis principia? Aequalitas. Ea si adest, sanitas adest. Rursus si morbus est, ergo inaequalitas est. Volumus remove morbum, removenda inaequalitas. Inaequalitatem postea accipit, et eam in sua principia resoluit. Sed quae sunt inaequalitatis causae? Recessus a temperamento per calidum, frigidum, humidum, siccum. Et cognito per signa, quod sit per frigidum, seu excessus in temperatura per frigidum, ergo reducenda est per calidum."

27. Montanus: Meth. Med. Univ. p.15

"sed non possumus gradum istius caliditatis vel frigiditatis scire, nisi gradum scias, qualiter in sanitate talis fuerit, et posito quod excesserit ad frigidum, ut duo, habeatque, ut duo frigidum, oportet invenire medicamentum calidum, ut duo, quod ut duo calefaciat. Quaerit igitur medicamentum, et invenit frictionem, quae ut duo calefaciat."

28. Montanus: Meth. Med. Univ. p.15

"Ecce quomodo nunc ultimum in discursu, in opere primum est. Per frictiones enim reducit ad temperamentum, temperamentum ad sanitatem perducit. Sanitas autem fuit primum in resolutione, ultimum autem in executione. Frictio autem ultimum in resolutione, primum in executione."

29. Montanus: Meth. Med. Univ. p.15

"Incipit enim haec ab uno simplicissimo sicut resolutiva ab uno particulari composito incipiebat, et sic procedit: Sanabis hominem, si calefacies, quia reduces eum ad sanitatem, id est, ad aequalitatem, in qua est sanitas."

30. Montanus: Meth. Med. Univ. p.15-16

"Modus iste non docet principia, verum est per methodum, sed imperfectius, quia qui resoluit, scit componere. Qui vero componit, nescit resolvere. Modus iste aptior est pro iunioribus, qui ad resolutivam methodum non sunt apti."

31. Montanus: Meth. Med. Univ. p.17

"Si debet versari circa ea adiumento rationis, et ratio sit circa universalialia et particularialia, iungat universalialia particularialibus, quia non potest fieri aliquid cum ratione circa particularialia, sed servatis universalialibus in mente, particularialibus applicare oportet. Sed nulla methodus facit hoc praeter resolutivam et divisivam. Divisiva enim ab universalialibus penetrat usque ad particularialia. Resolutiva vero a particulariali incipit, et resolvit usque ad prima principia."

32. Montanus: Meth. Med. Univ. p.17

"Nunc de ipso ordine doctrinae disserendum est. Galenus igitur primo artis parvae inquit. Tres sunt ordines doctrinae. Qui locus diu sane doctores ipsos vexavit, et torsit. Non enim imaginari possunt, quomodo ordinibus illis viae illae ordinentur, nec animadvertunt, quod doctrina vel via doctrinae ab ordine differant."

33. Montanus: Meth. Med. Univ. p.17

"Differunt, inquam ea differentia, qua subiectum differt a passione, et ab essentia doctrinae fluxit ordo, sicut ab essentia subiecti passio, nec imaginatione concipi potest doctrina sine ordine, quo est addiscenda ex arte . . . Est autem ordo, contextus eorum et consequentia, quae ducunt ad actum, ita ut unus ab alio dependeat a principio usque ad finem, et propterea ordo non separatur a doctrina. Differt vero doctrina ab ordine sicut passio a subiecto. Ordines autem qui in doctrina servantur, non possunt esse, nisi tres, nec plures, nec pauciores . . . "

34. Montanus: Meth. Med. Univ. p.18

"Alius ordo incipit a compositis, et resolvit ea in causas, et sua principia, et ita resolutivum ordinem servat, quem non servavit aliquis praeter Galenum, ideo se iactat, cum dicit: Solus ego ordine resolutivo usus sum, et in lib. de constit. artis tali utitur ordine. Incipit enim a notione finis, id est, ab obiecto artis, et resolvit in principia, et causas, donec ad prima deveniat. Quem ordinem nos trademus, imitantes Galenum in ordine, non tamen in re, nec procedemus alio calle, quam quo Galenus processit."

35. Montanus: Meth. Med. Univ. p.18

Chapter XV is headed: 'Totius medicinae Methodus per ordinem resolutivum tradita' and begins:-

"Nunc ponamus ob oculos totam medicinam, ut uno intuitu omnia fundamenta speculemini, quae quia methodo tradere volumus, non aliunde incipere possumus, quam ab eo, quod Galenus proponit 1. Method, ubi dicit, quod methodus omnis oriatur a conceptione finis."

36. Montanus: Meth. Med. Univ. p.18

"Sed dicat aliquis: Quid est incipere ab huiusmodi notione finis? Methodus resolutiva accipit aliquod subiectum, et resolvit ipsum in sua principia. Sed iam videamus, quomodo facta resolutione a notione finis constituamus artem? Medicina est ars cuius finis est sanitas. Ratione enim sanitatis medici addiscunt artem, et operantur. Finis ergo sanitas est. Si volumus constituere artem, oportet concipere finem istum, non dico ipsum nomen, sed naturam eius."

37. Montanus: Meth. Med. Univ. p.18

"Concipimus autem finem eius pro conceptu universali, quod est quoddam bonum, quia homines cum habeant eam, sani sunt, et operantur. Cum aegri sunt, et eo fine privati, operari non possunt. Si est bonum quoddam, nascitur propositum statim in nobis, ut assequamur illud bonum. Ideo duo hic sunt, unum est cogitatio finis intenti, id est sanitatis. Alterum sanitatis propositum, est appetitus bene operandi, recteque assequendi sanitatem, cum non adest. Si vero adsit, conservandi. Hoc est medici propositum, a quo immediate nascitur methodus inventa a fine, quia finis movet agentem sub conceptu boni. Nascitur ergo appetitus sanitatis sub conceptu boni. Cum non adest, acquirendi, cum adest, tuendi. In universali concipimus conceptum, et hoc modo incipit initium medendi et artis, ut dicit Galenus de opt. sect. ad Thrasybul. et lib. de artis constit . . . "

38. Montanus: Meth. Med. Univ. p.18-19

"Volumus inducere sanitatem, quod bonum est, sed hoc facere non possumus, nisi sciamus principia, quibus sanitas constituitur. Prius ergo sciendum hoc est, Homines universalem, et communem conceptum de sanitate concipiunt, esse illam formam naturalem quandam convenientem humano corpori, a qua proveniunt operationes, et actiones secundum naturam . . . Si sanitas forma est conveniens corpori humano, a qua proveniunt actiones secundum naturam, necessario in quadam aequalitate consistet. Quia omnis forma naturalis et omnis potentia naturalis conveniens subiecto in quo est, consistit in aequalitate quadam, quia natura facit instrumenta, et subiecta quae operantur, convenientia secundum complexionem et formam pro operibus agendis, et omne quod operatur secundum propriam temperiem, secundum aequalitatem operatur. Si enim fuerit aequale, recte; si inaequale, perperam operabitur. Cum igitur sanitas sit talis forma, necessario sequitur, quod in aequalitate consistat."

39. Montanus: Meth. Med. Univ. p.19

"Ergo si una aequalitas fuerit in corpore humano, una tantum erit sanitas, nec oportebit plures sanitates quaerere. Si vero plures erunt aequalitates, tot erunt sanitates, et ex inaequalitatibus aegritudines."

40. Montanus: Meth. Med. Univ. p.19

"Sed in corpore humano tres sunt compositiones, ergo et tres aequalitates . . . Prima compositio est, in qua ex mixtione quatuor primarum qualitatum temperatura resultat. Secunda est compositio membrorum similarium. Tertia est ex dissimilaribus, quae ex similaribus fiunt."

41. Montanus: In Artem Parvam, p.41 recto

See the passage "de his autem unum aliud verbum . . . et iste est tantum unus progressus via resolutiva."

42. Montanus: In Artem Parvam, p.42 recto and verso

". . . me ponere differentiam inter viam resolutivam, sive methodum, et inter ordinem resolutivum, quae via resolutiva est progressus unus simplex accipiendo, quod est multiplex, et resolvendo id in sua principia: ordo autem resolutivus habet quidem magnam similitudinem cum via resolutiva: nam sicuti via incipit a notione finis, et solvit in sua principia: sic etiam fit ordo resolutivus, sed in aliquo differunt. Differunt in hoc quoniam via resolutiva non est multiplex, sed simplex et proponit sibi finem particularem in scientia: at ordo est multiplex, et non proponit sibi finem particularem in scientia, sed universalem: ut quando quis proponit finem in arte medicina qui finis est sanitas, et est finis universalis: deinde ille dividit eam in sua principia dividendo et materiam et formam. In partibus, et divisionibus omnibus fiunt et multae resolutiones, et multae etiam divisiones, et multae definitiones, multaeque demonstrationes."

43. Montanus: Meth. Med. Univ. p.26

"Et cum quatuor tantum sint methodi doctrinae, concludimus, quod nulla possumus individua cognoscere. Qua igitur arte? Per accidentia et per sensum individua cognoscuntur, quia sensus habet obiecta particularia . . ."

44. Montanus: Meth. Med. Univ. p.26

"Sunt autem actiones seu operationes humanae cuiuscumque individui hominis, ex quibus naturam singulorum discimus cum consideramus tam naturales, quam animales actiones et quaecumque sensibus apparent atque ex illis particularibus universalia iudicamus."

45. Montanus: Meth. Med. Univ. p.26

"Et hic incipimus veluti sub umbra ostendere, quomodo universalia applicentur particularibus. Et circa hunc ordinem versatur medici ars per signa procedendo, de quibus copiose agemus postea."

46. The passages on signs I have taken from the Opuscula Varia (Basle, 1558), the Latin heading of chapter 56 is 'De vi et natura signorum' on page 112 of the Opuscula.

47. Montanus: Meth. Med. Univ. p.112 (Opuscula)

"Et ita docuimus, ut iam invenerimus per viam resolutionis causas suas: sed quoniam versamur circa particularia et ob id artifices sensibiles appellamur, oportet cogitare causas morborum: sed in particularibus id facere non possumus, quia particularia per sensus notificantur: causae autem non cognoscuntur per sensum, quia universalis sunt, sed ab intellectu tantum percipiuntur: causae ergo latent sensus."

48. Montanus: Meth. Med. Univ. p.112 (Opuscula)

". . . ideo per signum evidens et apparens sensibus procedere debemus ad causarum cognitionem. Et iste affectus deprehensus, cum signum sit particulare et sensui apparens, excitat sensum, postea refertur ad intellectum, et ab ipso concipitur: deinde comparat ipsum ad causas latentes, et facit analogismum, quae est relatio quaedam particularis ad universale."

49. Montanus: Meth. Med. Univ. p.112 (Opuscula)

"Istud igitur quod repraesentatur intellectui, cum sit particulare in individuo apparens, et affectus dum apprehenditur ab intellectu, comparat ipsum causae recognitae iam ab intellectu, sub modo universali: et recognoscit eum dependere a causa, et memoratur a signo illo, et ex tali rememoratione fit scientia."

50. Montanus: Meth. Med. Univ. p.113 (Opuscula)

"Exempli gratia: cognoscitis naturam ignis, et cognoscitis in ipso hanc proprietatem, quod emittit fumum. Lateat ignis in aliqua parte, cognoscitis quidem ignem, sed non ibi existere, sed emergit fumus: quo percepto a sensu, cognoscitis ibi ignem adesse. Ita faciunt signa apparentia sensui, ita deprehensa a sensu. Per deprehensionem enim hanc cognoscitis in corpore esse affectionem illam, cuius proprium est signum illud."

51. Sanctorius: Commentaria in Artem Medicinalem Galeni (1632, Lyons, to be referred to as Comm. Art. Med.) the heading of chapter I question X p.26 reads:

"An ordo, seu doctrina definitiva sit diversa a compositiva et resolutiva."

52. Sanctorius: Comm. Art. Med. p.26

"Omnes fere Peripatetici in hac re videntur reluctari Galeno; dicunt enim doctrinam definitivam nullo modo distingui a resolutiva, neque dari alios ordines, seu doctrinas ordini inhaerentes, quam ordo resolutivus, et compositivus, videamus igitur eorum fundamenta; ea enim pro defensione Galeni reiiciemus, et Galeni doctrinam definitivam confirmabimus."

53. See Sanctorius: Comm. Art. Med. the whole of chapter I Question X p.26-30

54. Sanctorius: Comm. Art. Med. p.61-62

"Dubitatio oritur, cur Galenus dixerit, medicinam non esse particularium; quia videtur, quod medicus versetur circa particularia . . .

"Respondetur medicum nullo modo tractare, vel curare particularia, vel singularia ut talia sunt . . ."

55. Sanctorius: Comm. Art. Med. p.62

". . . ex Galeno enim lib. de optima secta, et primo ad Glauconem habetur, morborum expulsionem a specifico affectu indicare: ergo quod curatur est specificum, et non singulare."

56. Sanctorius: Comm. Art. Med. p.62

"Praeterea si Medic. singularia ut sunt singularia curaret, vana esset ars, . . . quia ars, et omnes habitus intellectuales sunt universalium, et non particularium, ut docet Aristoteles . . . quia in particularibus nihil continetur . . . si particularia curarentur, illorum indicationes nobis non ostenderent remedia, quia non datur progressus a particulari ad particulare; esset igitur ars medica omnino vana, et ridicula."

57. Sanctorius: Comm. Art. Med. p.62

"Praeterea si inductio, quae procedit a multis particularibus, non concludit, nisi in 3. figura cum conclusione universali, qui modus concludendi ab Aristotele indicatur vanissimus, quanto magis si curarentur particularia ipsa."

58. Sanctorius: Comm. Art. Med. p.62

"Essent igitur indicationes vanissimae et nihil concludentes. Hinc Galenus 9. methodi cap.6. dicit in universalibus esse methodum medendi, in particularibus vero solum methodi exercitium: colligimus ergo medicinam versari circa universalia, et non particularia."

59. Argenterius: In Artem Medicinalem Galeni Commentarii Tres (1566, Mondovi, to be referred to as In Art. Med. Comm.) Index verborum . . . "Gal. methodum a se propositam non observavit."

"Gal. damnatur quod dicat thoracis amplitudinem sequi cordis caliditatem."

60. Argenterius: In Art. Med. Comm. p.10

"Unde constat plura esse instrumenta docendi quam quattuor, sunt enim sensus, intellectus, resolutiva, compositiva, diffinitiva, divisiva doctrina, resolutio, compositio, divisio, diffinitio, syllogismus demonstrativus, dialecticus, sophisticus, enthymema, inductionem exemplum, epilogismus. Quibus addi possunt analogismus et (ut diximus) experientia, autoritas . . ."

61. Argenterius: In Art. Med. Comm. p.9

"Non enim sufficit nomina exponere, res definire, dividere, et illius proprietates explicare, sed etiam causas illarum, et effectus saepe docere convenit: Ad haec non docet haec methodus."

62. Argenterius: In Art. Med. Comm. p.9

"Practerea potest solum convenire methodus singularibus rebus explicandis, non autem accommodari potest artibus universis inveniendis constituendis, et docendis: quemadmodum ex proemio huius operis patebit."

63. Argenterius: In Art. Med. Comm. p.9

". . . spectamus enim in rebus probandis non quid ratio, et sensus nostri, quos natura nobis ad rerum cogitionem dedit, docere possint: sed quid Aristoteles, Galenus et quod deterius est quilibet alius de ea re scripserit, illorum sententias colligimus, et libros nostros consarcimus, et detestanda temeritate edimus, laboramus praeter modum in authoribus conciliandis, quod nullus unquam ex praestantissimis authoribus fecit. Et dum aliorum iudicio vivimus, ostendimus nos non homines, sed bestias esse."

64. Argenterius: In Art. Med. Comm. p.188

"Et primo quod Gal. non probet tres esse, sed dubitet de naturali, de vitali dicat nullam esse evidentem demonstrationem; verum solum rationi esse consonum, ut recipiatur. De animali autem esse evidentem demonstrationem. At ex quibus quaesio ea sumitur. Nam excusis omnibus eius libris nulla reperitur alia nisi ex plexu retiformi. At ille non est in hominibus, aut

certe non ita evidens, ut in brutis: cum tamen homines postulent puriorem spiritum, et propterea evidentiorum plexum et magis artificiosum."

65. Argenterius: In Art. Med. Comm. p.188

"Deinde etiam si ponatur, non tamen sequitur, illic fieri aliquem spiritum: sicut non sequitur, fieri in revolutione vasorum spermaticorum. Praeterea si retia huiusmodi sint necessaria ad generationem spirituum, cur etiam illa non sunt in corde, ad generationem vitalis."

66. Argenterius: In Art. Med. Comm. p.188

"Secundo falsam ostendit hanc esse opinionem eo, quod dicat animalem spiritum nunc ex vitali, nunc ex aere inspiratio, nunc ex sanguine gigni, dicatque esse ignae substantiae. Tertio quod non possit assignare locum, ubi gignatur. Nam aliquando eum in plexu, aliquando in ventriculis cerebri et nunc in duobus anterioribus, nunc in medio, nunc in postremo, nunc in venis quae ad ventriculos pertinent, illos gigni scribat."

67. Argenterius drew upon Aristotle's conception of the soul for his idea of the one spirit. This is made clear in Argenterius: In Art. Med. Comm. p.188

"Unus ergo spiritus: quem nec vitalem, nec naturalem nec animalem vocare debemus, si intelligamus his nominibus diversam esse illius formam et naturam: sed ita vocare possumus ut Aristoteles animam unam dicit esse, quae ob diversam relationem nunc sensitiva, nunc motiva nunc vegetativa dicitur."

68. Sanctorius: Comm. Art. Med. p.737-738

"Totum enim medicinae artificium consistit in perfecta cogitatione anatomiae . . .

". . . Hinc Vesalius, et alii Anatomici ausi sunt contra Galenum multa summa cum ratione in lucem promere, causa est, quia Galenus non erat valde in anatomia humana versatus: primo enim de anatomicis admini. cap.2. faretur, se toto vitae suae cursu duo tantum vidisse humana cadavera admodum imperfecta . . . ideo nonnulla de humano cadavere pertinentia ad situm . . . non videtur percepisse: sicuti dunc asserit dextrum renem et dextram emulgentem esse alteriorem . . . quamvis in brutis horum situs sit eo modo, quo Galenus de hominibus putabat . . ."

69. Sanctorius: Comm. Art. Med. p.333

"Argenterius qui numquam huius libelli artificium penetravit, qui Galeni arcana non intellexit, qui supposita non animadvertit: ideo in sexcenta errata lapsus est."

70. Sanctorius: Comm. Art. Med. p.181

". . . spiritus animalis natura discrepat a vitali quod non cognovit Argenterius . . ."

71. Sanctorius: Comm. Art. Med. p.182

"se non vidisse anatomen humani cerebri: quia plexus retiformis est conspicuus et non est exiguus conspici possit. Secundo vacillat, quia putat esse Galeni sententiam in plexu retiformi fieri spiritum animale, quod nunquam somniavit Galenus, qui solum voluit plexum suppeditare et praeparare materiam pro generatione spirituum animalium, ut deinde spiritus animales in ventriculis fieri possent: errat postremo dum dicit, pro generatione vitalium non requiri plexum: hoc non est contra nos, quia non tenemus solum in plexu vasorum praeparari alimentum spirituum."

72. Sanctorius: Comm. Art. Med. p.182

"Galenus enim putat sanguinem in dextro ventriculo cordis praeparari, ut in sinistro fiant spiritus: Columbus ait praeparari in pulmone: Io. Botalus in ductu, qui est a dextra ad sinistram auriculam cordis. Io. vero Ulmus ait in plexu arteriarum splenis praeparari materiam pro spirituum generatione:

73. Sanctorius: Comm. Art. Med. p.182

"ecce quod saltem ex Ulmi sententia datur plexus pro generatione spirituum vitalium quare argumentum Argenterii omnibus viribus destituitur."

NOTES - CHAPTER VIII

1. Laurentius: Hist. Anat. (1599) p.1
2. Crooke: Micro (1615) p.1
3. Crooke: Micro, p.3
4. Crooke: Micro, p.3
5. Crooke: Micro, p.4
6. Crooke: Micro, p.4
7. Crooke: Micro, p.8
8. See chapter 7, page 225 where Montanus is quoted as stating that the principle or form of health is equality.
9. Frances Yates: Giordano Bruno and the Hermetic Tradition (1964, to be referred to as Bruno) p.35-36
10. Yates: Bruno, p.33
11. Yates: Bruno, p.31
12. Crooke: Micro, p.6
13. Crooke: Micro, p.12
14. Crooke: Micro, p.12
15. Crooke: Micro, p.12
16. Crooke: Micro, chapter VI, p.14
17. Crooke: Micro, p.14
18. Crooke: Micro, p.15
19. Sir Thomas Browne: Religio Medici in The Works of Sir Thomas Browne (edited by Geoffrey Keynes, Faber & Faber, 1964) Vol. I, p.23-24
20. Crooke: Micro, p.24
21. Crooke: Micro, p.24
22. This is true only in a very general sense, for, as I have previously written, Vesalius did express doubt about basic theory when his anatomical observations were not consonant with it.

23. Crooke: Micro, p.25
24. Crooke: Micro, p.26 and Laurentius: Hist. Anat. p.15
25. Crooke: Micro, p.26
26. Crooke: Micro, p.19
27. Crooke: Micro, p.27
28. Crooke: Micro, p.15
29. Crooke: Micro, p.3
30. Crooke: Micro, p.13. Chapter V is entitled "How profitable and behoovefull Anatomy is to the knowledge of Mans selfe."
31. Du Chesne: The Practice of Chymicall and Hermeticall Physicke. . . translated by Thomas Timme (London 1605) See, for example, Chapter XI, signature G.2. "Moreover, we see in the bowels of the earth of the little world, man, no lesse then in the great world's belly; in the bellies I say of both, almost the same effects are to be seene of Meteors, as wel waterie as fierie. For example, the Tympanie, the swelling of the Coddess, windinesse of stomæch, and bellie: al which dos represent the windes, raynes, and Earth-quakes of the earth: and the waters within the body, and betweene the skin and the flesh, doe represent the Sea, the Rivers and Springs of the earth."
32. Mondino: Anathomia (Singer) p.59
33. Mondino: Anathomia (Singer) p.59
34. Charles Singer: The Scientific Views and Visions of Saint Hildegard (1098-1180) in Studies in the History and Method of Science edited by Charles Singer (1955) Vol. I, see especially p.30-43
35. Mondino: Anathomia (Singer) p.60
36. Translated by O'Malley: Vesalius, p.323
37. Translated by O'Malley: Vesalius, p.324
38. Caspar Bauhin: Institutiones Anatomicae (Lyons, 1604) in Dedicatory Epistle:

"Mercurius Trismegistus, cuius scripta quae extant nihil nisi altum et sublime spirant, et quem Platonice melioris notae, Mosem fuisse profitetur, ILLUSTRISS. PRINCEPS, HOMINEM miraculum magnum, animal DEO similimum..."

39. Bauhin: Institutiones Anatomicae ... Dedicatory Epistle
 "hinc uno fere consensu omnes πικροκόμοι appellarunt
 Plinius, mādi epitomen . . ."
40. Crooke: Micro, p.37
41. Laurentius: A discourse of the preservation of the sight ... translated by Richard Surplet (London 1599)
 in 'To the Reader', Signature A.3
42. Daniel Sennert: Thirteen Books of Natural Philosophy ...
 translated by Nicholas Culpeper and Abdiah Cole
 (London 1660, to be referred to as Nat. Phil.) p.395
43. Sennert: Nat. Phil. p.401
44. Sennert: Nat. Phil. p.401-402
45. Sennert: Nat. Phil. p.413
46. Sennert: Nat. Phil. p.413
47. Sennert: Nat. Phil. signature B.2
48. Sennert: Nat. Phil. signature B.3
49. Browne: Urn Burial in The Works ... Vol. I, p.166

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Appendix

Translation of the tables and last sentence of the chapter entitled 'De Suprema omnium Morborum divisione' which is appended with the translation

<p>of the simple there are four types</p>	<p>Warm Cold Wet Dry</p>	<p>ANY BAD TEMPERAMENT HAS FOUR GRADES AND ANY GRADE HAS THREE DEGREES. (MANSIONES)</p>
<p>There are eight bad temperaments</p>	<p>Similarly of the composite, four</p>	<p>Warm and Dry Warm and Wet Cold and Dry Cold and Wet</p>

SO THAT 96 DEGREES OF UNNATURAL BAD TEMPERAMENTS ARE RECOGNISED BY DOCTORS AND NOT MORE

Translation of table in page 100 verso of Methodi Vitandorum Errorum which is appended on page 358 of this thesis

" . . . omnia signa propria peccantium humorum reduci videntur ad tria capita, ad sapores, colores, et periodos humorum . . ."

[" . . . all the proper signs of bad humours are seen to be reduced to three headings, flavours, colours and (their proper) times . . ."]

in the humours, therefore, of our body there appear to be observed only these six genera of flavours which are

either

insipid sweetness	—	watery phlegm, similar or dissimilar (i.e. concocted or undigested)
manifest sweetness	—	blood
bitter	—	bile
salt	—	salt phlegm
vinegar	—	melancholy and phlegm
brine	—	burnt melancholy, glassy melancholy and phlegm

METHODI VITANDORVM ERRORVM

De suprema omnium Morborum diuisione. Cap. IIII.

VM in librum hunc illa Empiricorum errata, dum transcunt de genere in genus, & Ideas confundunt; non percepta affectuum præter naturam forma, & Idea; congesserimus. Par est exordiri à summa omnium morborum generum, & symptomatum diuisione in suas species, & hanc uniuersalissimam diuisionem à doctrina Galeni ubertate haurire, & strictim eam colligere; & merito postquam ab alijs libentissimè est supposita atque probata: propterea à nobis erit recipienda tamquam specimen, & exemplar præsentis cognitionis; & eò libentius, cum prauideam nostri temporis sycophantas saltem non reclamaturos aduersus Galenum, qui merito ab omnibus extollitur ad sidera, & cuius laus ita edito loco est collocata ad quæ obtrectatores, uel inuidi pertingere minime poterunt; aggrediamur ergo morborum supremam diuisionem, deinde symptomatum, ex Galeni sententia.

Morbi erunt vel intemperies, vel mala compositio, vel soluta unitas. Intemperies erunt simplices, vel compositæ; simplices, ut calida, frigida, humida, sicca; Compositæ, calida sicca, calida humida, frigida humida, & frigida & sicca: Octo ergo erunt intemperantiæ: nec mihi obijciat, præterea dari intemperies cum materia, quoniam nullus error magis a veris initijs, & fundamentis analyticis abhorret, quam in diuisionibus transcendere de genere in genus, & vitiosam proponere diuisionem; transcendimus, dum intemperierum fieret diuisio in simplices, & cum materia, à genere formarum, in genus causæ efficientis: intemperies enim sunt formæ; humores vel materiæ facientes intemperies sunt causæ efficientes; ostendimus, ubi egimus de humoribus, efficientes causas: quare non est, ut de intemperiebus cum materia loquamur, & incidamus in talè laqueum tam manifestè ab Arist. explosum 2. libro post. Octo igitur enarratarum intemperantiarum, quælibet uel esse potest in primo gradu recedens à temperato; uel in secundo; uel tertio, uel quarto, sic enim antiquis Medicis placuit ad quartum usque diuidere: & quem uis gradum diuidere in tres mansiones: quare intemperantiæ expensæ secundum suas ideas, & formas (dimisso illo uitioso transitu formarum in efficientes causas) si enumerabimus mansiones, erunt 24. 12. in simplicibus & 12. in compositis & omnes enumerabuntur nonaginta sex mansiones recedentes a temperatissimo, hæc enim sunt supposita atque probata, & non decet perpetuo à primis exordijs litigia suscitare, sed supponenda tanquam initia præsentis contemplationis.

Mala compositio erit, uel in numero, uel magnitudine, uel mala conformatione. Numerus uel deficiens, uel superfluus: deficiens erit, dum abscinditur pars, dum uritur, dum putrescit, uel ob congelationem contrahitur; superfluus, ut pterygion in oculo: lumbrici; lapis in uesica: Magnitudo aucta, & diminuta.

Mala conformatio quatuor sub se habet subalterna genera, uel est figura uitata; D uel asperitas; uel leuitas; uel cauitas.

Figura uitatur uel in utero, uel foris, Vnde nasus simus, acutus, oculi concaui; scapula in alarum modum; conuulsiones, tabes, elephas, &c.

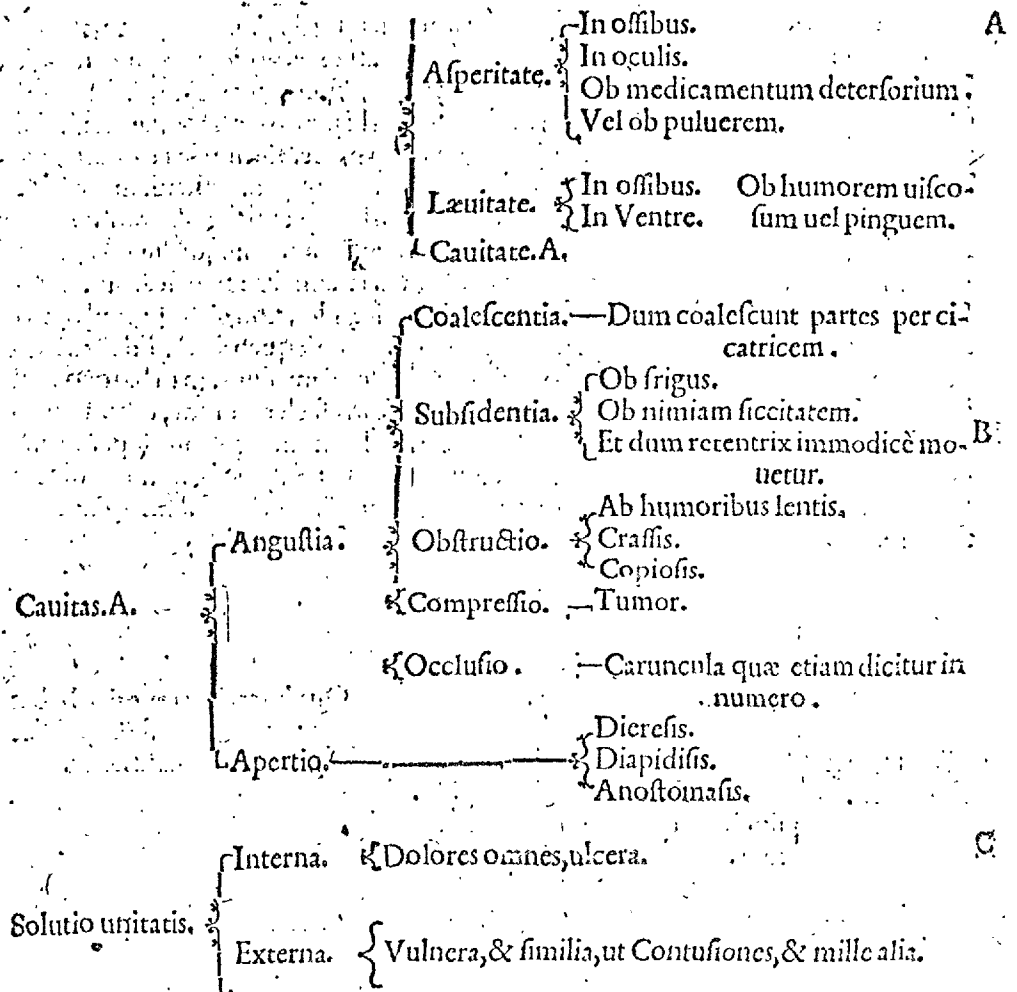
Asperitas, ueluti dum ob acres humores aliquando in ossibus fit; uel ob medicamentum abstergentia; uel in oculis ob puuerem, uel fumum.

Leuitas, ueluti ob humorem uiscosum, & pinguem in ossibus, & alijs partibus: ut in uentriculo, in lienteria.

Cauitas habet duo genera; aliud quod est in angustia, uel in patefactione nimia; sub angustia quinque sunt species; coalescentia, subsidentia, obstructio, compressio, & occlusio; coalescentia fit dum coalescunt partes; subsidentia ob frigus, uel ob nimiam siccitatem, & dum expultrix facultas immodicè mouet; obstructio uel à lentis, crassis, uel copiosis humoribus, compressio, ut ob tumorem; occlusio ob cartilam.

Sub

METHODI VITANDORVM ERRORVM



Hæc referunt specimen omnium formarum morborum, ad quod si quispiam spoliatus sanitate angitur morbis; necessario debet ad has ideas, & formas genericas omnes reduci.

De Symptomatum omnium diuisione breuissima. Cap. V.

SYMP TOMATA omnia in tria genera diducta sunt; cum aliqua sint exeuntia; aliqua qualitates mutata; aliqua sint actiones læsæ: Et actio, quæ debet esse radix symptomatum omnium tam in qualitate mutata, quam in exeuntibus mutatis, sola in suas species debet partiri: cum ad actiones, tamquam ad symptomata primi ordinis omnia exeuntia symptomata, & omnes qualitates resoluentur: actio ergo erit uel naturalis, uel animalis, uel vitalis: naturalis sub se continet alteratricem, expultricem, retentricem, & attractricem; & qualibet ex ijs esse potest uel ablata, uel diminuta, uel deprauata; animalis quæ sub se continet reetricem, sensitiuam, & moriuam; & qualibet ex ijs potest esse uel ablata, uel deprauata, uel diminuta; uerbi causa, animalis reetricis deprauata erit delirium; est affectus pertinens ad discursum. Et sic de alijs. Sensitiua continet quinque sensus; Motiua, sicuti motus totius, sicuti inquietudo: tremor; uel motus partis, ut respiratio, quæ ad pectus; singultus, quæ ad stomachum; vomitus ad ventriculum; Tussis ad pectus, uitalis dum uires languent.

Symptomata

METHODI VITANDORVM ERRORVM

Ostenditur, quomodo ex saporibus, tamquam ex signis proprijs colligere possimus, qui nam sint humores prædominantes.

Cap. II.

Quindecim humorum differentia ex Gale. colliguntur.



VINDECIM uidentur esse famosæ humorum omnium nostri corporis differentie; in primis enim Galenus 2. de differentijs feb. capite 6. enumerat quattuor species pituitæ, dulcem uidelicet, acidam, uitream, & falsam, deinde lib. de atra bile capite 2. & alibi proponit septem differentias humorum biliosorum, scilicet pallidam, flauam, uitellinam, porraceam, æruginosam, ceruleam quam Græci *ισαρόδον* appellant, & rubram, demum eodem loco, & 3. de loc. affectis tres melancholias, fecem sanguinis naturalem, fecem sanguinis adustam, & bilem flauam assatam, postremo est sanguis: ad quindecim igitur has differentias à Galeno obseruatas referuntur humores omnes, qui copia, uel qualitate humana corpora perturbare possunt: Qui quantitate solum peccant, sunt pituita dulcis, bilis pallida, flaua, rubra, sanguis, & fæx sanguinis; quoniam in quolibet sano corpore hi humores reperiuntur; quique dum quantitate non excedunt, magnum fructum afferunt humanis corporibus: quinimò, si horum aliquis deficeret, uiuens non possèt conseruari. Humores uero, qui qualitate peccant sunt uitellina bilis, porracea, æruginosa, cerulea, fæx sanguinis adusta, & bilis assata, pituita uitrea, falsa, acida, ab ijs re uera prodeunt innumerabiles affectus præter naturam, quare erit pernecessarium, ut prius per signa propria, antequam ad signorum syndromem accedamus illos omnes peruestigemus.

Cœterum, quia superius dictum est, quod omnia signa propria peccantium humorum reduci uidentur ad tria capita, ad sapes, colores, & periodos humorum; de saporibus prius est agendum: Sapes igitur humorum peccantium, quâ tum mente, animoque colligere potuimus reduci uidentur ad ista sex capita, quæ sunt distincte declaranda, si uolumus humorum existencias peruestigare

in humorib ⁹ igitur nostri corporis uidetur obseruari posse solum hæc sex genera saporum, quæ sunt	vel	dulce insipidum — pituita aquosa similis uel dissimilari
		dulce manifestū — sanguis
		amarum — bilis
		falsum — pituita falsa
		acetosum — melancholia, & pituita
		ponticum — melancholia adusta, uitrea & pituita.

Hæ igitur ualent consequentia, est sapor insipidus, ergo est pituita aquosa similis, uel dissimilari, hinc Galenus 2. de differentijs feb. capite 6. dicit, quod insipidus sapor conuenit pituitæ aquosæ: Est sapor dulcis manifeste dulcedinis, ergo est sanguis per se, ichor uero sanguinis, uel rubra bilis per accidens; quia ex Galeno 9. methodi 12. & ex Aristotele 2. post. unum ut unum solum unam in dicat naturam, & 2. priorum habet, ab unica natura unicam tantum prodiere proprietatem, & unicam proprietatem unicum fontem, & unicam solum originem arguere, quare licet dixerimus insipidum significare pituitam aquosam, uel dissimilarem, quæ est illa, quæ partim cruda, partimque est cocta, unicum tamen intelligimus, quod est aquosum, experisque aliorum humorum; Ad eundem modum dicimus saporem dulcem manifeste dulcedinis, sanguinem, uel ichorem in dicare, quia sanguis est per se dulcis, ichor uero per participationem, quia dicit Galenus 2. de fac. naturalibus 9. quod dulcedo est proprietates sanguinis, quare ichor

Ab unico sapore unum tantum humorem per se indicari, & non plures.

PARTIVM TABVLAE.

De partibus nutritorijs generales tabule.

Ex cibo chylum conficiunt, utpote precipue ventriculus, deinde intestina, quae & leuam quandam chyli perficiendi facultatem obtinent.

Chylum maiori ex parte confectum distribuunt, quae facultas precipue intestinis attribuitur, quamuis haec etiam pluribus numeribus destinata sint, nimirum concoctioni, & excrementorum tum exceptioni tum delationi.

Chylum ad epas ex intestinis attractum deferunt, nimirum uenae mesaraicae.

Chyli superflua, feces uocata, deferunt et colligunt, ut sunt intestina, inter quae graecilia distributioni, crassa superfluis recrementis excipiendis & euacandis destinata sunt.

χολώδες, id est, Chylificationi: harum aliae

Nutritioi de sinete, quarū aliae inferuūt

Sanguinem faciunt, ut epas.

Optimo nutrimento, quarum aliae

Sanguinem ad suam perfectionem perductum toti corpori transmittunt, ut uena caua cum suis ramis.

χυμώδες, id est, sanguificationi: harum quaedam destinata sunt

Vesica bilis trahens bilim.

Sanguinem purgant, quae tria sunt, ut

Lien humorem melancholicum exuens
Renes, qui serosum humorem ex sanguine eliciunt.

Partes in abdomine uel inferiori uentre collocatae, seu ipsi antrae, sunt duplices, nempe uel

Sanguinis excrementis, quarum aliae

Superflua sanguinis deducunt ad propria excrementorum receptacula, ut sunt

Vena portae ad lientem

Meatus biliosus ad uesiculam fellis.

Vreteres, urinam ex renibus ad uescicam deferentes.

Hisce omnibus nutritorijs partibus, alijs ad meliorem operationem perficiendam, aliae ad conseruationem partium, ut sunt peritonaeum, omentum, pancreas.

Recrementa sanguinis excipiunt, ut

Lien.
Vesica bilis.
Vesica urinaria.

Generationsi inferuientes, de quibus paulo post, signo X.

Excretioni inferuient quorū quaedam

Intempestiuam excretionem prohibent, ut

Vesicae urinae Sphincter.
Recti intestini Sphincter.

Tempestiuam incitant, ut musculi ad dominis, precipue autem recti.