M. Gelfand

Diagnostic Procedures in Medicine

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Foreword

I consider it a great honour to be asked to write a foreword to this excellent account of the science and art of clinical diagnosis.

In 1956 I found myself a member of the Nuffield Committee appointed to plan a medical school in the University College of Rhodesia and Nyasaland in Salisbury. It was then I got to know Michael Gelfand and became very quickly aware of his dedicated enthusiasm and outstanding skill as a clinician. Professor Gelfand, as he became, has been the biggest single factor in the resounding success of the Godfrey Huggins School of Medicine which, at first an affiliated school of the University of Birmingham, became in 1971, well able to stand on its own feet, as the independent Faculty of Medicine of the University of Rhodesia. Its graduates, both of European and African stock, are of high quality and the earlier ones are already taking their postgraduate qualifications.

This book represents the wisdom of a life-time spent in busy clinical practice of a man endowed with exceptional powers of observation, rigorous self-criticism and the capacity to write in a vivid lucid style. Much of the charm of the book derives from the fact that it is the work of one man. This has resulted in a balance and perspective which contrasts with the inevitably patchy nature of multi-author texts.

There is a very proper emphasis on taking of a careful history and the importance of a thorough, disciplined physical examination. The place of the relevant biochemical and biophysical investigations is outlined clearly.

I prophesy with confidence that this book will prove of great value to countless students of clinical medicine not only at the undergraduate stage but to those preparing for the clinical part of higher examinations such as the M.R.C.P. Indeed, no physician however experienced, can fail to derive benefit from its eminently readable pages.

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W. MELVILLE ARNOTT

Preface

Books intended for teaching the principles and practice of medicine are many, and almost every large medical centre can boast of one. Why then is there a need for so many and well may we ask—is there a reason for another to appear and so flood an already swollen market? The answer is simple. Medicine is a great calling, possibly the greatest of all, and for one to enter it, requires a personal discipline, a devotion to it, a love or an enthusiasm. An appreciation of the importance which medicine attaches to the quality of its practitioners has made me want to give to its students something of this message. Each one who has written a book of this nature must have been motivated by similar feelings, hoping, perhaps thinking that someone, somewhere may be kindled by its message and take up the torch so that it will never fade out.

Teaching medicine is a thrill. For centuries medical schools have been in existence and the art of imparting this knowledge to students has been handed down from generation to generation of physicians in the pages which are dedicated to the principles of medical teaching.

Most important in coming to a diagnosis is the ability of the clinician to adopt the correct procedure, and much detail has been devoted therefore to the history, physical examination and the investigations which are carried out in order to confirm the provisional diagnosis made.

A book of this nature is perhaps better written by a number of physicians, each an expert in his own field. But it may be argued that the general physician with experience of most ills is possibly in a better position to attempt such a task since he sees the body as a whole with a comprehensive appreciation of the relationship between its different parts and possibly with a sympathy more attuned to the single finite mind of the average medical student and graduate, burdened as it is increasingly with ever widening factual horizons, besides which, a desirable unity of purpose may well be better achieved by the single author.

In writing this book I have endeavoured to stress the essential clinical facts which all undergraduate students of medicine should know, and I have included further detail in the hope that graduates preparing for a higher medical degree or diploma may be enabled to fill those gaps in their knowledge.

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Chapter 1

The Evolution of Clinical Signs

About 2,300 years ago the Hippocratic school taught that when a person was sick the only way to arrive at the cause of the illness was to study the body itself and not to look for any mystical force, power or outside influence which might have entered it. It taught that the doctor should not concern himself with outside spiritual or metaphysical matters but should concentrate on the body and its organs. Thus, although the doctor of that period knew little about anatomy, as dissection was not yet permitted, he was instructed to take note of the patient's appearance—whether he looked ill—the state and beat of his pulse and so on, for by a knowledge of these signs he could gauge the prognosis. This was the first breakaway from the mystical or magical type of medicine so commonly practised at that time and for many years afterwards. Hippocrates introduced what is often referred to as 'clinical observation'.

The Greek school also postulated a kind of chemical theory which depended essentially on an imbalance in one or more of the body humours or liquids—phlegm, blood, yellow and black bile produced within it. These in turn originated from the four elements of air, water, earth and fire from which the cosmos was derived. If any one of these humours was in excess the body temperament changed and disease followed. Thus we got the four temperaments of sanguine (hopeful), melancholic (sad), phlegmatic (cool) and choleric (angry). There was no real concept of a circulation of the blood except that the body humours must have passed from one part to another by some mechanism for which no explanation was offered. Life was maintained by every individual breathing in the animus, or *vital spirit,* from the atmosphere.

The Hippocratic school became the accepted one for medicine and its teachings remained largely unchanged until A.D. 130 when Claudius Galen introduced at least two very distinct advances. First, through dissection of different animals, he drew the profession closer to the anatomical or local concept of disease, even though much of what he taught about anatomy applied to animals and not to man as he insisted. The second great contribution to clinical medicine was that while he recognized the accepted theory of the causation of disease, as enunciated by the Greek school, he postulated the existence of a kind of circulation starting from the heart. In this organ the vital spirit mixed with the blood, which was not pumped through the body by it, but reached the nerves and brain by a flow and ebb rather like the tides of the sea.

Galen's hypothesis was quite ingenious, for he postulated that a man breathed in the pneuma which passed into the lungs and thence through the pulmonary vein to the right ventricle where it became mixed with blood containing the natural spirit which entered it from the liver. In the right ventricle the pneuma and natural spirits combined to form the vital spirit. But how could the blood reach the left ventricle if the two ventricles were separated from each other by a thick interventricular septum with no obvious communication between the two ventricles? Galen postulated that there must be invisible pores which enabled the blood to pass from the right to the left ventricle. The animal spirit once formed now passed down the arteries and nerves to excite movement.

Because of Galen's hypothesis medical men began to look more to the body, and so it is not surprising that, especially after Galen, they took more notice of the body temperature. In the seventeenth century Sanctorius devised a 'thermoscope' to give the clinician some idea of the body temperature, but the thermometer, as we know it, appeared late in that century. In clinical medicine the doctors also noted that the urine passed in sickness varied quantitatively and qualitatively as did the sediment seen after it had been left standing; the height of the sediment in the matula (the container used for measuring it) became important.

The urine in the matula was divided into four limbs with the uppermost one corresponding to the head, the next to the thorax, the third to the abdomen, and the lowest to the genitalia. And so the clinician was guided to the part of the body most affected. Thus we see how the physician in the Renaissance period was searching for any objective evidence which would help him to gauge the degree of the illness the patient might have. In the same era we find the great Paracelsus suggesting that in disease there may be changes in the urine not ordinarily detectable by the matula and that much useful information could be obtained by the use of vinegar, extractions, coagulation or distillation of the urine—vital facts indicating how disease hitherto hidden could be revealed.

Sanctorius also produced his 'cotyla' or primitive watch for counting the pulse rate but it was not until the early eighteenth century that Sir John Floyer made a better model for this purpose. Once Galileo had found a means of accurate timing with the pendulum Sanctorius was able to introduce into clinical medicine his pulsimeter by which the pulse rate could be more readily determined.

Then in 1628 came Harvey's epoch-making demonstration of the heart as a pump which maintained the circulation, and although the full significance of this discovery was somewhat slow in being appreciated by the profession, yet, as a result, medicine made distinct practical advances in the meantime. Some years after Harvey's *De Motu Cordis* Stephen Hales (1677–1761), a minister of religion in England, passed a brass pipe down the artery of the thigh of a mare and with it measured the blood pressure for the first time. Again the significance of this did not immediately have a medical bearing or relevance to man. Mention should be made of Thomas Sydenham (1624–1689), the great English physician at St. Bartholomew's Hospital, often referred to as the 'English Hippocrates', who pointed out that each disease, like a flower, had its own characteristics. In other words Sydenham realized that for each disease there was a particular group of symptoms or special features of its own.

It was about this time, in 1658, that Charles Boyle noticed that air was required for a lighted candle to continue burning and that a small animal kept in a confined space died after a time. Clearly there was something in air which was necessary for the maintenance of life. Then came the interesting observation of Richard Lower who noticed that dark venous blood became bright red in the arteries as it circulated through the lungs of animals. What was this vital substance present in the air that was necessary for life? We still had to wait another 100 years before Joseph Priestley (1773–1804) was able to show that a gas was emitted by burning mercurius calcinatus and that candles burned more strongly in its presence and mice became more active in it. But it was left to Antoine Lavoisier (1743–1794) to consolidate this discovery by heating a known quantity of mercury for a few days in a confined space and measuring the volume of air before and after the experiment. He next exposed the red oxide of mercury to greater heat and was able to show that the liquid mercury and volume of air were restored to their original weight and volume. He called this vital air oxygen. These and subsequent experiments led him to prove that in breathing, CO_2 and water are formed and that animals depend on the oxygen just as the lighted candle does. The fuller significance of Harvey's discovery of the circulation was now becoming appreciated, and the study of chemistry had extended to the realm of physiology.

At the time of Harvey, pathology was hardly a science, and there was no attempt to connect the lesions seen at autopsy with the complaints of the patients. In fact, as late as the seventeenth century Theophile Bonet (1620–1689) reported on his findings in 3,000 autopsies and, though he described some of the macroscopic lesions he did not go beyond this. Indeed it was not until 1761 that the Italian Giovanni Battista Morgagni (1682–1771), published his great work *On the Sites and Causes of Disease*. In this he showed for the first time that a lesion found at autopsy corresponded with the symptoms complained of by the patient during life.

Although the microscope, which Galileo had introduced, suffered from serious defects, Malpighi (1628–1694) successfully demonstrated the existence of capillaries, which had been suggested by Harvey as the link between the veins and the arteries. About this period Leeuwenhoek (1632–1723) of Holland also carried out microscopic studies with simple lenses, demonstrating red blood corpuscles, spermatozoa, and bacteria, and Robert Hooke (1635–1702) of the Royal Society conceived the word 'cell', suggesting that cork, as an example, was made up of little boxes or cells separate from one another. But these first microscopes gave a blurred visual image, and it was not until about 1820, when better lenses were devised, that Morgagni's great studies on morbid anatomy could have their real value. Hooke's cell was now seen as the unit from which all living tissue was formed. In 1850 Koelliker published the first textbook on histology, and only eight years later there appeared Rudolf Virchow's great work on cellular pathology which described how the cellular changes of diseases, like cancer, could be adequately recognized.

With Morgagni's discovery there followed, as might be expected, a number of major advances which helped the clinician to recognize these post mortem lesions. Until then doctors, when doing a physical examination, only inspected and palpated the body, but in the second half of the eighteenth century a young Austrian doctor, Leopold Auenbrugger (1722–1809), introduced percussion into clinical medicine. He wrote a booklet on this technique, and it is interesting to note how he stumbled across it and was the first to apply it in clinical medicine. His father was an innkeeper and he observed him regularly going round tapping the barrels of beer to determine how full they were. Auenbrugger saw at once how this could be applied to determining whether there was fluid in the body by the dullness of the percussion note elicited over the affected part.

Auenbrugger's use of percussion as a clinical aid was followed not long after by the next very important contribution of the stethoscope, by Rene Theophile Laennec (1781–1826) of Paris. He observed how men working in the sewers called out to their colleagues at long distances from them. Applying this observation to medicine he placed a roll of stiff paper to the region of the heart and heard its sounds. He had the genius to realize to what he was listening. Thus in 1820 a new clinical method was introduced in medicine. Men now began to ask how the heart sounds were produced and what effect disease had on their quality. Physicians too by now had discovered that breath sounds in the lungs varied from a certain quality in health to a different one in disease. Improvements in the design of the stethoscope followed; flexible rubber was used instead of wood and it was found that two ears were more effective than one. From all this grew a far better and more efficient way of recognizing disease in both lungs and heart. By 1850 the binaural stethoscope was being adopted in all centres of medicine. The modern physician had arrived on the medical scene.

At the beginning of the nineteenth century clinical medicine had at its disposal inspection, palpation, percussion and auscultation. Medicine was fast becoming a science of facts, with more attention being paid to the significance of the patient's complaints. This can be appreciated from the manual written by Martinet, in Paris, in 1826. In it he gives a very elaborate method of eliciting the sick person's story. This called for a history of the family as well as a detailed account of the previous history of the patient together with details of his habits and idiosyncrasies. Included also was a description of the diseases which might have occurred in the 'critical' periods of life (infancy, puberty, maturity and senility). From this information a detailed account of the history of the present complaint was compiled.

Advances in scientific knowledge in physics and chemistry too had their impact on medicine. The discovery of electricity had a tremendous influence on medicine. First Galvani (1737–1798) observed that the dissected legs of frogs twitched, a phenomenon which he attributed to animal electricity flowing down the nerve. After further knowledge gained by Volta and others it was observed in 1858 by Koelliker and Muller that electrical waves could be recorded from a contracting heart, and in 1870 Richard Caton noted the same phenomenon in the brain of men. These observations were further developed, leading ultimately, at the beginning of this century, to the introduction into clinical medicine of the ECG and a little later in 1929 of the EEG by Hans Berger.

Also of considerable value to medicine in the electrical field was Michael Faraday's (1791–1867) discovery of cathode rays in tubes from which gas had been exhausted. This prepared the way for the discovery of x-rays in 1895 by Roentgen (1845–1923); he was able to show that rays could pass in varying degrees through differing tissues and could be depicted on a photographic plate. By 1900 x-ray machines were being used in all large centres.

It would be fair to say that once the existence of oxygen was proven by Priestley and Lavoisier the science of biochemistry came into being. When David Livingstone went out to Africa there were virtually no biochemical tests available for clinicians. It was the great Richard Bright of Guy's Hospital, who in 1827, by appreciating the relationship between albuminuria, oedema and renal failure, brought chemistry into the field of medicine. He conducted autopsies on patients who had died from dropsy and albuminuria, observing the altered structure of the kidneys. Almost at once there followed a renewed interest in urine testing; the routine included recording the quantity passed in a day, its colour and reaction and the presence of coagulum precipitating on boiling. Diabetes mellitus was suspected when the urine gave the characteristic sweet taste and its specific gravity was over 1030.

With a better idea of the functions of the blood, clinicians turned their attention to its chemical analysis, since the concentration of urea was found to be higher in urine than in the blood. Berzelius postulated that the kidney eliminated nitrogen products by converting them into urea, while William Prout was able to show that hydrochloric acid could be demonstrated in the stomach. A little later, towards the beginning of the twentieth century, blood glucose estimations were being used to confirm the diagnosis of diabetes mellitus. But that was not all. The great German chemist Justus von Liebig (1803–1873) was able to show that fats and carbohydrates were broken down in the body into carbon dioxide and water and proteins into urea and uric acid. He also claimed that the organic matter of animals and plants could be broken down into proteins, fats and carbohydrates. Equally great was Claude Bernard (1813–1878) who saw the blood as the vehicle which brought oxygen and nutrients to the cells and at the same time removed waste substances. He also found that the first stage of digestion took place in the stomach and that the pancreas carried on the digestion further through its juices. He also demonstrated how sugar, after absorption from the small gut, was stored as glycogen in the liver.

Another very important point which followed Harvey's discovery of the circulation was the realization that the blood pressure could be estimated and that an elevated pressure might have other effects on the body. Karl von Vierordt first attempted to measure the blood pressure clinically by observing what pressure was necessary to obliterate the pulse at the wrist; this beginning was followed by improved methods. The modern sphygmomanometer with its mercury column and arm-band filled with air was introduced by Riva Rocci in 1896. For analysing cardiovascular mechanics the cardiac catheter was employed in horses in 1860 by Chauveau and Marey who produced records of intraventricular pressures. But it was not until 1929 that Forssman passed a catheter down one of his own veins into his right ventricle. In 1941 Cournand and MacMichael introduced this procedure as a reliable method of investigation.

A great step forward in our understanding of cardiac disorders came with Sir James MacKenzie's (1853–1925) polygraph which allowed the action of the right atrium and ventricle to be better understood by recording the movements of the jugular veins in the neck. By carefully studying these waves in health and in disease a far clearer understanding of what happens in heart disease was gained until other, better and easier methods replaced MacKenzie's polygraph.

The student is apt to think that the methods and techniques used by the doctor at the bedside are outmoded, even perhaps unreliable when compared with the complicated machines found in scientific laboratories today. This is all relative, and nothing could be further from the truth. Indeed, provided the doctor adheres to the proven methods faithfully he will never have any regrets and his patients will profit from his advice. This does not imply that specialized pieces of apparatus are not useful in helping the doctor to make a diagnosis more quickly or indeed more accurately. The point to be emphasized is that unless the doctor has conducted a careful examination and used the well-tried practices which have stood the test of time he will not be in a position to know which of the more complicated procedures to employ, nor indeed when they are really necessary for diagnosis.

Chapter 2

Useful Clinical Principles

How is the doctor to handle his patient? He is to be competent not only in reaching a satisfactory conclusion as to what is worrying the patient but also in ensuring that the latter has confidence in his advice and his management of the complaint.

Basic to any good relationship between the patient and his doctor is that the medical man should be capable of using his diagnostic aids intelligently. In the first instance he has to unravel the mystery of the sick man—no easy task when we remember the complicated make-up of man and his very variable personality, but equally he must take cognizance of his own. Just as the patient may have certain drawbacks, which make the taking of the history more than ordinarily difficult, so the mood, interest and enthusiasm of the clinical investigator can change, resulting in almost an incompatibility between the two people so intimately concerned with each other. And so, because of the inability of the two personalities to come closer together, the truth is not discovered and the sick person may suffer.

To practise medicine properly the clinician must remember to follow a number of principles or laws. These he must always keep before him, as he is constantly faced with problems which cannot be answered very quickly simply by knowledge or past experience of a disease. He cannot remember the cause of every symptom or sign in whatever combination they may appear in every disease. He cannot cover every contingency. In spite of carrying out the necessary procedures he may find, as indeed occurs in practice, the answer is not always forthcoming. So I have attempted to define the basic principles which will help him to reach the correct one. It is important too to realize that after making a diagnosis it is necessary to treat the sick, and here again he must not only be able to handle his patient but often the patient's family as well.

'De Omnibus Dubitandum' (We must doubt everything)

I have always taught my house physicians that the correct way of finding out from what a patient suffers is to follow the Newtonian principles. In this approach the scientist forms a hypothesis; he then proceeds to test it by experiment, and the conclusion he reaches depends entirely on the results he obtains. This is the process of induction, and from this point he proceeds to the next step, seeing how far his original hypothesis differs from or agrees with his findings at each stage.

On the other hand not every clinical problem is quite like a research project based on a hypothesis. There are certain details to be learnt from the clinical history. There are findings, such as the temperature and pulse, signs detected during an examination, or more important there are pathological findings obtained from the laboratory or radiological specialists, which have to be assessed before the clinician makes up his mind and reaches a definite or a possible diagnosis. Each of these details has to be accepted or doubted—any one could be wrong. The nurse may not have recorded the temperature correctly; she may have reported that the urine specimen was free of glucose, correctly if the patient is diabetic with a raised renal threshold for sugar.

De omnibus dubitandum means that one has to reflect at every stage of the history and physical examination when assessing all the details which go to make a diagnosis. The approach is scientific—a method of thinking deeply on the records of a case. One must never jump to conclusions or take a short cut. Every relevant detail that can be checked should be assessed for accuracy and, if necessary, confirmed.

To Think Anatomically

The principle 'to think anatomically' is possibly the most important one in helping the clinician to reach a diagnosis. It is probable that the concept of disease having a localized significance and being located at the site to which the patient refers his complaints started with Galen, or perhaps earlier with Hippocrates, although I am not altogether clear on this point. Certainly at the time Morgagni wrote his *On the Sites and Causes of Disease* the real importance of symptoms being related to a lesion in a particular part was not a usual way of thinking by clinicians. The African witchdoctor and also the early doctors in Mesopotamia and Babylon all shared the view that disease was caused by a spirit which could settle in any site and cause symptoms anywhere in the body, be it a headache in one patient, diarrhoea in another, constipation, vomiting, wasting, fever and so on in others. There was no need to study the body as the cause was external. The object was to exorcise the evil from it and at the same time to give a herb or medicine to neutralize the ill-effects caused by the spirit.

The tendency of the student and doctor is to think in terms of a disease and try to fit the patient's symptoms into the diagnosis. But often this is not easy and it is on such occasions, that he forces the symptoms he finds to fit his