Second edition

A new system of anatomy

A dissector's guide and atlas

Lord Zuckerman

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Preface to second edition

The term 'anatomy' is used in the title of the *New System* in its strict sense of dissection by 'cutting asunder', and not more generally to signify the body of knowledge which comprehends all that is known about the structure and relations of the parts of the human frame. To make the purpose and design of the book absolutely clear, I have now subtitled it '*A Dissector's Guide and Atlas*'.

In essence, the book provides a series of instructions which the average medical student should be able to follow on his or her own in the dissecting room, without calling unduly for help from demonstrators. To this end, the text was repeatedly revised before it was originally published, and also furnished with a comprehensive series of realistic illustrations, as opposed to idealized pictures of what a student was supposed to see when he dissected.

Needless to say, the structure of the body has not changed in the twenty years since the book has been in use. Experience has, however, shown where some further changes can be made both to simplify even more the task of the student and to allow for the fact that the never-ending expansion of the medical curriculum as a whole has meant that the hours that medical students are expected to spend in the dissecting room have, in some schools, had to be reduced. The same principle which governed the design and writing of the first edition has therefore been used to delete, where possible, instructional detail whose omission it is felt will not be prejudicial to the amount of anatomical knowledge which is indispensable to the medical student both in his further studies and in his subsequent professional career. Experience has also indicated the advisability of rearranging the suggested order of dissection of a few parts of the body, particularly of the upper part of the neck. The instructions for the dissection of the heart have been simplified, and a new section added to deal with the practical problems of dissecting the brain when shortage of material does not allow of each group of students being given two specimens to study. The sections on the limbs and the abdomen have been least changed. New paragraphs of instructions on surface anatomy have been added to help the student study the actions of muscles and movements of joints.

A few illustrations have been omitted as being unnecessary when text has been reduced, for example in the description of the thoracolumbar fascia, and a limited number of new ones added. At the same time, the opportunity has been taken to reverse

some figures so as to make their left to right orientation constant. Others have been reduced in size when doing so has not affected clarity.

Obviously, the more time a student devotes to his dissection the better will be his knowledge of the structure of the body. The custom in the Birmingham Medical School when I launched the book was to devote some 300 hours to the dissection of the whole body. I am assured that the present text could be satisfactorily mastered in about 200.

A further simplification has been introduced by changing the nomenclature used in the book. In the original edition I mainly followed the international system known as the Paris *Nomina Anatomica*, or PNA, and, as far as possible, the English versions of the Latin terms. But with the continuing decline in the teaching of Latin in schools, and with the failure of the international *Nomina Anatomica* to come into general use, it has been thought sensible to make no reference at all in the text to Latin terms except where they are in common use. In those exceptional cases where no PNA Latin form was ever available, the book continues to employ whatever English term for a structure is in commonest use in English-speaking countries.

The original double-entry index has been retained, and Latin entries are now followed by the English terms. The Index can thus serve as an English–Latin, Latin–English dictionary for those anatomical terms used in the text; but it cannot be regarded as either an exhaustive or as a necessarily accurate guide to the latest, the fourth, edition of the *Nomina Anatomica*. The aim has been to maintain as great a degree of compatibility with the current international terminology as English usage allows.

I am grateful to several colleagues in schools other than Birmingham who were kind enough to write to me after the book first appeared, pointing out minor textual errors which inevitably seem to creep in regardless of the care that is taken to avoid them. The necessary corrections were made in the second and later impressions of the First Edition, Dr Peter Dallas Ross, who had given unstintingly of his help in the preparation of the book, undertaking their collation.

The close examination of the text which has resulted in such changes as have been introduced in this Edition was mainly the work of Dr Deryk Darlington and Professor Peter Lisowski. Dr Darlington was also responsible for the new instructions for the dissection of the brain (pp. 6.30 to 6.35) and Professor Lisowski for those dealing with the dissection of the heart (pp. 3.29 to 3.38). I am grateful to Professor Charles Oxnard, at whose suggestion some paragraphs on surface anatomy have been added and the lists of contents of the separate parts of the body modified.

The untimely death of Mr W. J. Pardoe, with whom I had worked so closely in devising the illustrations of the book, deprived me of his help in producing the new figures required for this edition. For these I owe thanks to Mr John Petty, and also to Mr Norman Pahy, who was responsible for Figures 5.23 and 5.108.

Lord Zuckerman
May 1979

Preface to first edition

Teachers of medical students have long agreed that some traditional parts of the curriculum must be streamlined if the student of today is to have time to learn about the many new fields of knowledge which now affect the practice of medicine. Indeed, with the accelerating growth of scientific knowledge, pruning would be necessary even if one were to contemplate an increase in the duration of a medical student's university life from its present span of six years to, say, seven or even eight. These considerations led me, some fifteen years ago, to reorganize the course of topographical anatomy in my own Department, and later, after experimenting with such texts as were available, to design a new practical book from the sequence of dissections which we adopted. My aim was to provide a guide to the course of instruction in regional anatomy which precedes clinical studies, and which, in the United Kingdom, leads to the Second Professional Examination in Medicine (the 'Second MB'). A first draft of such a dissecting manual was issued for use in typescript form eight years ago. Minor modifications were subsequently made in the text and then, starting some four years ago, the entire book was re-written in the light of the experience we had gained, and on the basis of an extensive series of new dissections specially made for the purpose.

Topographical anatomy is essentially a visual discipline, and my text accordingly deals only with the kind of anatomy that can be demonstrated and learnt in the dissecting room. All matters irrelevant to this purpose have, as far as possible, been excluded. The principle I have followed is to give directions for dissection and examination from which the student should be able to make his own observations and discoveries. As now published, the text has been rigorously and extensively tested in the dissecting room on numerous cadavers and by hundreds of dissectors. The sequence of dissections that is described covers the entire body, and can be adapted to practical courses of any desired duration, provided that a total of at least 300 hours is devoted to work in the dissecting room.

Knowing that the average student soon forgets the mass of anatomical detail he is sometimes enjoined to learn, and with the object of encouraging the kind of study which provides a three-dimensional idea of the structure of the body, I have tried to eliminate detail which has no apparent scientific or educational value, or which, to the best of my knowledge, has little obvious clinical significance.

No two anatomists are likely to agree precisely about what constitutes unnecessary detail in

the dissecting room. On the principle that a student should be asked to dissect only what can be dissected adequately, we hold that he should be discouraged from spending precious time trying to reveal features which can be demonstrated only on special preparations (for example, preparations which display the lymphatic system), and which can be conveniently learnt from a textbook. On the other hand, structures which can be easily demonstrated on the cadaver may not necessarily be important either scientifically or clinically, whereas something important may be difficult to display. How one draws a line between these two extremes is a matter of personal judgement. No one would deny that the student should have a clear idea of the course of the vagus nerve, or of the ureter, or of the ulnar nerve. These are all important structures. Correspondingly, it is generally agreed that the veins can usually be disregarded in a dissection. But if this latter principle were carried too far, it would mean that the student left his anatomical studies without knowing the disposition of the external jugular veins, or without knowing that the right suprarenal vein is so short that the right suprarenal gland is very closely applied to the inferior vena cava. The emphasis of a dissection might also be influenced by the ease with which some particular and relatively 'unimportant' dissecting room feature can be displayed. If, to give a specific example, the posterior superior alveolar branches of the superior alveolar nerves were difficult to display, I should not suggest to the medical student that he tries to dissect them, in spite of their clinical interest. In fact, however, they are easily dissected, and for that reason we suggest that our students do so.

In my view it is not the function of a pre-clinical department to teach the applied anatomy which is the concern of the surgeon or physician. When he moves from the Department of Anatomy to his clinical studies, the student should certainly be expected to appreciate what is involved anatomically in, say, the surgical approach to the heart or in the conditions of foot-drop or ulnar paralysis, after he has been told what these things mean from the point of view of medical practice. But I should not expect him to make a clinical diagnosis of foot-drop or ulnar paralysis merely on the basis of his work in the dissecting room. The primary purpose of a medical student's studies in the dissecting room, during his first or first and second pre-clinical years, can only be to provide an adequate knowledge of structure with which to articulate what is learnt in other parts of the medical curriculum. I am talking, of course, of the student who proposes following a career in some branch of medical practice, and not of the small number who are likely to make anatomy itself their field of specialist study.

I have introduced into the text no more and no less osteology than the student needs to understand how the soft parts of the body relate to its bony structure. The educational value of such osteological matters with which I have not dealt is extraneous to the understanding of dissecting room anatomy.

After experimenting with several methods of illustration, from simple line drawings to untouched photographs, I finally decided to rely mainly on touched-up photographs of actual dissections which display what a student should see when he follows the text. So far as possible figures have been placed either on the page opposite to the relevant text, or on the same page. A few have been repeated.

The nomenclature used is, wherever possible, an English equivalent of the Paris *Nomina Anatomica* (PNA) as agreed at the Sixth International Congress of Anatomists held in Paris in 1955, and as revised at the Seventh Congress in New York in 1960. The international

convention about the omission of hyphens between vowels has also been followed, but with regret and, at times, even with dismay. Further details about nomenclature are given on pages 0.6 to 0.11.

In most British dissecting rooms four students are concerned in a single dissection of the head and neck, which early on entails the removal of the skull-cap (calvaria) and, later, of other parts of the specimen, the remains of which finally have to be bisected. The method described in my own text is to bisect the head and neck at an early stage, as this makes it easier for pairs of students to dissect simultaneously without getting in each other's way. This technique, which was suggested to me by Dr F. P. Reagan, a former member of my staff, is very easy for the student to follow, and also makes it possible to examine cranial features from both their medial and lateral aspects. As indicated in the text, however, the stage where the bisection is performed can be deferred, if that is desired. Another technique that is advocated is decalcification of the temporal bone, in order to simplify the dissection of the middle and internal ear.

In the Department of Anatomy in the University of Birmingham the 300 hours of dissection my text entails are easily fitted into a student's first year in the Medical School. This obviates the need for lecturers and demonstrators to deal at one and the same time with overlapping years of students in the dissecting room—otherwise an inevitable consequence of the more conventional five-term course of most British schools. In order to help the student a certain amount of repetition and summarization has been deliberately introduced into the text of this dissecting manual (particularly in the section on the head and neck, whose dissection does not follow as flowing a course as that of other parts of the body). For convenience, a brief statement of the layout of the lymphatic system has been included as an appendix to this book. Under the Birmingham system the student also has an opportunity to consolidate what he learns in the dissecting room through separate classes in Surface and Radiological Anatomy. Courses on Neurology, in which Neuro-anatomy and Neuro-physiology are combined, and on Growth, are given when the student has completed his studies in the dissecting room.

The average total time devoted to the study of the different parts of the body in my own dissecting room is as follows:

Upper Limb	44 hours
Lower Limb	44 hours
Thorax	23 hours
Abdomen	75 hours
Head and Neck	117 hours

While the form, content and style of this book are my responsibility, it could never have been written without the loyal co-operation of many who have served on the staff of my Department over the past eight years. I wish especially to acknowledge my debt to Professor C. F. V. Smout, who willingly accepted a large part of the practical burden of introducing our shortened practical course and of preparing the first duplicated text we issued. In this work Dr D. Darlington and Dr W. P. Dallas Ross also gave considerable help, as they later did in seeing that my final text was as consistent as possible in the use of the PNA terminology and in arranging the index. To both of them, as also to Dr P. Beavon, Dr S. H. Green, Dr R. W. Heslop, Dr J. T. Hobbs, Dr F. P. Lisowski, Dr G. D. Officer, Dr J. B. Pearson, and Dr W. L.

Whitehouse, I owe a great deal for the care with which they carried out dissection after dissection in order to provide the material for the illustrations, and to help check the text which is now published; as well as for their help with the proofs, an arduous task in which other lecturers on the staff of the Department also assisted. To Mr W. J. Pardoe I am as grateful for the tolerance he showed over my exigent demands as I am appreciative of his skill in elaborating a system of illustration which provides a more realistic representation than a line drawing of what the medical student actually sees in the dissecting room. Here I owe thanks, too, to Mr T. F. Spence, for his assistance both in photography and dissection. To my secretary, Miss E. R. Lawton, I am greatly indebted for her care in typing successive drafts of the text. I am grateful, too, to Mr E. A. Sims for providing an inordinate amount of material for special dissection, and to the hundreds of students who were the unwitting 'guinea-pigs' in an experiment of producing a new book on anatomy.

My indebtedness extends beyond the confines of my own Department. Professor A. L. d'Abreu, Dean of the Medical School in the University of Birmingham and Professor of Cardiac Surgery, Professor W. Melville Arnott, William Withering Professor of Medicine in the University of Birmingham, Professor F. A. R. Stammers, Professor of Surgery in the University of Birmingham, Professor J. Dixon Boyd, Professor of Anatomy in the University of Cambridge, Professor A. J. E. Cave, Professor of Anatomy in the Medical College of St Bartholomew's Hospital in the University of London, have all read my text and been generous in encouragement and constructive comment.

S. Zuckerman
University of Birmingham, 1961

Contents

Part 6: The brain

Introduction

The dead body which you will study was injected shortly after death with a solution which usually consists of a mixture of industrial alcohol, formalin, carbolic acid, and glycerin. The injection is generally made into the femoral artery at the upper end of the right thigh, and the fluid perfuses the whole body. The tissues are, therefore, both sterilized and preserved, at the same time as the glycerin prevents them from becoming too hardened. Every effort has been made to ensure that when you dissect you will not run any hazard of being infected by bacteria or viruses that may have been in the body at the time of death.

Different medical schools have different ideas about the proportions of the ingredients used to make up the injection liquid. Most of these differences are arbitrary, but some are made necessary by climatic conditions, preservation usually being more difficult in hot than in temperate zones. Once preservation of the cadaver has been achieved, it is customary in some schools to render the arteries of the body more conspicuous with a coloured injection mass. This is done in various ways, one of the commoner being to inject a mixture of starch and carmine into the arterial system through the same opening in the femoral artery through which the preserving fluid was introduced.

Do not be surprised if it turns out that someone has a better-preserved body to dissect than you have (or vice versa). A large number of factors influence the way injection fluid flows through the body.

It is convenient to dissect in pairs, except in the case of the thorax, abdomen, and head and neck, where dissections are usually made by groups of four. Your main concern will necessarily be the cadaver which you are dissecting, but always allow colleagues who are working on other bodies to see what you are doing, and, whenever possible, check your own findings on their dissections.

Section 0.1

How to dissect

Instruments

Scalpels and forceps are the main instruments you will use. Your scalpels should be sharp, and furnished with blades of at least two different sizes. Scalpels with expendable blades are the most convenient, and blades with a sharply-curved cutting edge will be found the most useful. These should be changed frequently. To avoid accidents, be careful how you carry your scalpels when not in use. Note that the term 'heel' is applied to that part of the blade closest to the shaft.

You should have at least two pairs of forceps, one with broad, the other with fine serrated jaws. A stout pair of toothed forceps is useful when you reflect skin, and you will find those with a weak spring less tiring to use.

Scissors are also necessary, and again you will find it useful to have more than one pair.

Because they do not rust, it is a better investment to buy instruments made of stainless steel, or of good quality plated steel.

It is well to equip yourself, too, with a metal probe or seeker, and a magnifying glass. You may find it useful to have both a blunt and a sharp-pointed seeker. Other instruments which you will occasionally need, such as bone forceps, an amputation-saw (or tenon-saw), a frame-saw and a double-edged skull-saw, and a long-bladed knife, will be provided as part of the equipment of the dissecting room [Fig. 0.1].

The cadaver

The institutional arrangements for disposing of the dead vary from country to country, and except in very primitive parts of the world every death has to be officially notified to the authorities. Bodies are made available for dissection only under strictly controlled regulations, and, apart from bodies of people who have expressly asked that their remains be used for medical science, those that become available to medical schools are usually those of the indigent whose remains have not been claimed by relatives for ritual burial or cremation. Anatomy schools in countries where the expectation of life is high, that is to say about seventy years or more, will as a rule receive only senile cadavers. In the years from 1950 to 1960 the average age of male and female subjects in the dissecting room of the Birmingham School of Anatomy was 72. The senile body not only differs from the body of a young person in lacking teeth (i.e. in being edentulous) and having atrophied masticatory muscles and thinned jaw bones, but also in the relative proportions of various other structures. Some bodies may be emaciated, others may have a lot of subcutaneous and other fat. Not surprisingly, many of the bodies which come to the dissecting room reveal the marks of previous disease. You may even find that the cadaver you are dissecting is that of a person who died of cancer. In that case you may have to study the affected parts on some other body.

While the general arrangement of the muscles, vessels, and nerves which make up the body follows the same pattern you will discover during the course of your dissection that anatomical details vary considerably from one individual to another. So do not be surprised, for example, if in the cadaver you are dissecting, an artery arises from some main trunk differently from the way described. Indications are given in the text about those structures which are most variable in their disposition.

Another point worth noting from the start is that the appearance of the tissues in the cadaver is very unlike that of the same tissues in the living body. For example, arteries are differentiated more easily from veins in the living body than in the dead; different planes of fascia are separable more readily on the operating-table than you will find possible in the cadaver you are dissecting; and organs and muscles are more fixed in position in the cadaver. Their colour, texture, and surface-markings are also different in the living as compared with the body prepared for dissection by the injection of fixatives. Note, too, that the degree of distension of different parts of the alimentary canal are bound to differ in the cadaver you dissect from what would be expected in a healthy person. It is unlikely that someone whose body would be referred to a dissecting room would have eaten much solid food before death. At the same time mortuary attendants sometimes distend the terminal part of an otherwise empty alimentary tract, that is to say, the rectum, with tow, so making its appearance different from what it would normally be during life. All the figures used to illustrate this book are realistic representations of what your dissection will expose.

The techniques of dissection

Before you begin to dissect, it is *essential* that you read these instructions.

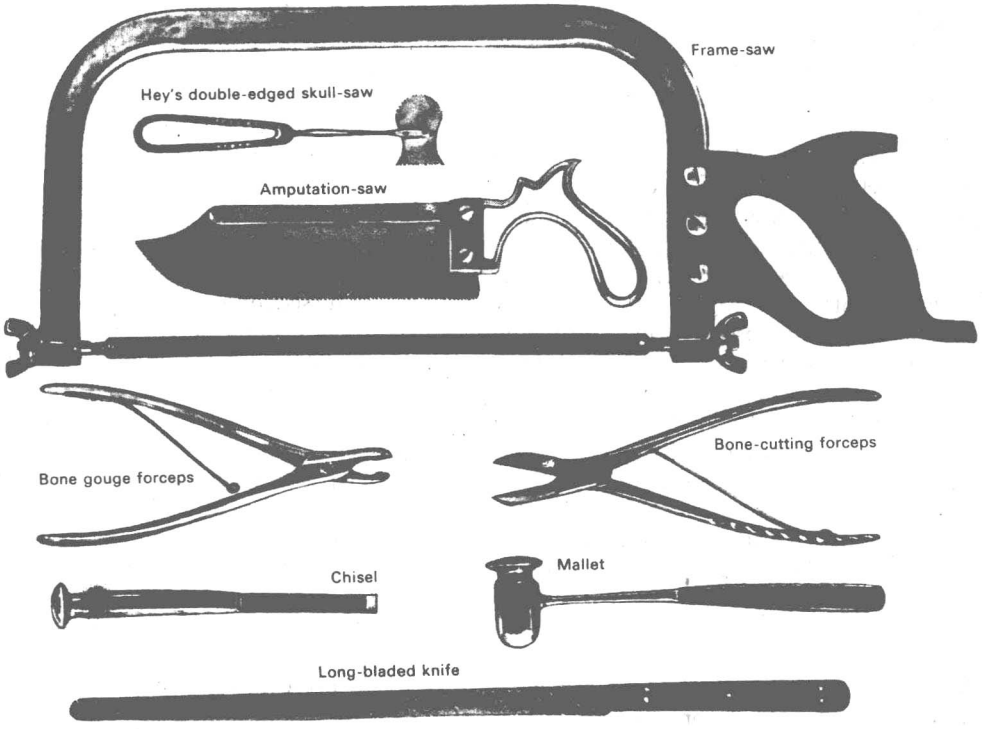

Fig. 0.1 Dissecting instruments.

Reflection of skin

You will be told the exact position of every skin incision you have to make. Cut through the skin, remembering that it is rarely more than 2 mm thick. A decrease in resistance as you cut will tell you when you reach the subcutaneous tissue.

To detach the skin from the subcutaneous tissue, use stout forceps to grip the angle where two incisions meet, and cut with your scalpel between the skin and the underlying subcutaneous tissue or fascia. As you lift the skin away (this is called 'reflecting the skin') pull on it, and continue cutting close to, and parallel with its under-surface, keeping the flap tense as you reflect it away. Most of your reflections will be made so that the flap you lift is left attached by one edge. The skin can then be replaced, between periods of dissection, over the part you are studying.

Reflection of fascia

The subcutaneous tissue between the skin and whatever structure it overlies (usually muscle) consists of fatty connective tissue known as superficial fascia, and a deeper layer of non-fatty membranous fascia called the deep fascia. The cutaneous nerves and vessels ramify in the superficial fascia, having pierced the deep fascia. Using a scalpel and forceps, the superficial fascia is then reflected from one of the edges of the area laid open by the reflection of skin. As it is turned back, care must be taken lest you inadvertently cut some of the cutaneous nerves or arteries which you may be asked to study.

Cleaning muscles, nerves, and arteries

By 'cleaning' a muscle, a nerve or a vessel, one means completely removing the connective tissue and fat or fascia by which it is ensheathed. This is done with forceps and scalpel, where necessary piecemeal. When you dissect do not hesitate to remove small veins, or for that matter, large veins, unless specifically told not to do so.

When you are asked to 'define' a nerve or artery, or a muscle, you are meant to carry on with the process of cleaning until the whole structure concerned is clearly and cleanly exposed. The same meaning attaches to the word 'following' a nerve or artery.

Any tissue that is removed from the body should be put into a receptacle so that it can eventually be buried.

Most of your dissection will be made with a sharp scalpel and forceps.

By 'blunt dissection' is meant the process of isolating a structure without using the blade of a knife. Blunt dissection often involves pulling a nerve or artery to one side, so must be carried out with care. One can, for example, separate a vessel which is bound by connective tissue to a nerve by pushing the points of closed forceps, or scissors, between