A TEXTBOOK OF

PHARMACOGNOSY

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B.Pharm., D. de l'U., F.P.S., F.R.I.C., F.L.S.

EIGHTH EDITION

BAILLIÈRE
TINDALL AND COX

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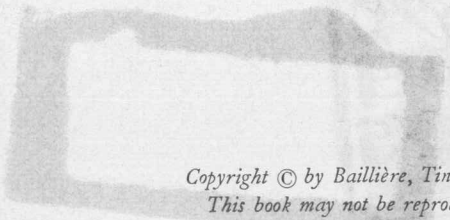

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PREFACE TO THE EIGHTH EDITION

THIS book was originally written to meet the needs of pharmacy students in Great Britain, but with the tendency of pharmaceutical education and practice to become more international it has become increasingly used in the universities of the British Commonwealth and of the United States of America. It is hoped that the changes made in the present edition will further increase the usefulness of the book in all those countries in which the English language is the medium of instruction. Although primarily intended as a student textbook it also appears to be used by many practicing pharmacists, analysts and economic botanists.

Pharmacognosy although an ancient subject is by no means a static one and at no period has it attracted more research workers than at the present time. Although the botanical side of pharmacognosy retains its importance for the student and all who handle drugs it is inevitable that most of the new work is concerned with the constituents of drugs and with the newer methods of physical and chemical evaluation. In spite of this trend no pharmacognosist worthy of the name will neglect the living plant or the macroscopical and microscopical characters of crude drugs. In the past much otherwise excellent chemical research has been marred by the fact that the plant material was not botanically authenticated.

In the course of the present revision additional space has been found for the historical development of pharmacognosy, for the constituents of drugs and for a number of the newer and more specialised aspects of pharmacognosy such as chemical races, the biogenesis of active constituents and the uses of radioactive isotopes. In order to treat of these matters without increasing the size of the book, space has been saved by omitting the rarely used appendix of the last edition and by setting the descriptions of a number of drugs of secondary importance to students in a smaller type. In spite of the additional matter the book is actually the same size as the last edition.

This and earlier editions owe much to many helpers, of whom I would particularly wish to mention my old students Miss E. M. Abbott (now Mrs. Horsfall), Prof. H. E. Street and Prof. E. O'F. Walsh and my present colleagues Dr. W. C. Evans, Dr. R. Hardman and Dr. W. B. Hugo. In this eighth edition contributions have been made by Dr. Evans on plant hormones, chemical races, hybridisation, polyploidy and tracer technology ; by Dr. Hardman on algal products, surgical dressings, saponins and species of *Dioscorea* ; and by Dr. Hugo on bacteria, antibiotics and enzymes. Once again the tedious but very important proof-reading has been done by Dr. J. M. Rowson. Although the sources of illustrations are acknowledged in the text I would specifically thank here for those which make their first appearance in the book by the kindness of the Port of London Authority, *The Chemist and Druggist*, William Ransom & Son, Ltd., the South Netherland Herb Association, the Institute of Horticultural Plant Breeding at Wageningen, Holland and Fritzsche Brothers Inc., U.S.A.

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CONTENTS

PART I. HISTORICAL INTRODUCTION

PART II. FROM PLANT TO CRUDE DRUG

PART III. DRUGS OF VEGETABLE ORIGIN

PART I

HISTORICAL INTRODUCTION

CHAPTER I

THE SCOPE OF PHARMACOGNOSY

> From the beginning, the study of plants has been approached from two widely separated standpoints—the philosophical and the utilitarian. Regarded from the first point of view, botany stands upon its own merits as an integral branch of natural philosophy, whereas, from the second, it is merely a by-product of medicine or agriculture. At different periods in the evolution of the science, one or other aspect has predominated, but from classical times onwards, it is possible to trace the development of these two distinct lines of enquiry, which have, at happy moments, converged, though they have more often, to their detriment, followed unconnected routes.
>
> AGNES ARBER : *Herbals, their Origin and Evolution*

THE study of plants and animals, particularly as sources of food, is one of the oldest of human activities. From the earliest times man had to distinguish between plants which were poisonous and those which were not and there gradually developed a knowledge of naturally occurring drugs which was transmitted at first orally and later in a written form as described in the next chapter. Whilst pharmacognosy is mainly concerned with naturally occurring substances having a medicinal action, it is not entirely limited to such substances. It includes for example other materials used in pharmacy, not for any medicinal action but as flavouring agents, suspending agents and so on.

The methods used by the pharmacognosist are applicable to the examination of many commodities such as spices, foodstuffs, gums, plant insecticides and vegetable fibres.

The name pharmacognosy is derived from the Greek, *pharmakon*, a drug, and *gignosco*, to acquire a knowledge of. It was first used in 1815 by Seydler in a small work entitled *Analecta Pharmacognostica*.

Pharmacognosy is closely related to both botany and plant chemistry, and its history entitles it to be regarded as the parent of both. As late as the beginning of the present century pharmacognosy had developed mainly on the botanical side, being particularly concerned with the description and identification of drugs both in the whole state and in powder, and with their history, commerce, collection, preparation and storage. Such branches of pharmacognosy are still of fundamental importance but the rapid development of plant chemistry and

pharmacology in recent years has led to an increased interest in these aspects of the subject. In particular, many plants never previously examined are now being screened for possible pharmacological activity and for active constituents such as alkaloids. It cannot be over-emphasised that, taking the plant population of the world as a whole, only a small percentage of species has so far been examined in these ways.

Whilst pharmacognosy has been generally pursued for utilitarian ends and may thus be called an applied science it has played a very important role in the development of the pure sciences, *e.g.* in descriptive botany, plant classification (taxonomy) and plant chemistry (phytochemistry). Similarly the large-scale chemical screening now in progress, although utilitarian in aim, will doubtless throw new light on our present taxonomic classification and possibly lead to an improved classification which takes into account both botanical and chemical characters.

CHAPTER II

HISTORICAL INTRODUCTION

> Many of us miss all that is most worth learning in old books through regarding anything in them that is unfamiliar as merely quaint, if not ridiculous. This attitude seals a book as effectually and as permanently as it seals a sensitive human being. There is only one way of understanding these old writers, and that is to forget ourselves entirely and to try to look at the world of nature as they did. It is not 'much learning' that is required, but sympathy and imagination.
>
> E. S. ROHDE: *The Old English Herbals*

ANYONE who becomes interested in the history of pharmacognosy finds himself with an almost limitless field of study. The subject cannot be readily confined to the study of drugs and one soon becomes involved in other aspects of pharmaceutical and medical history, in folklore, in economic history, geographical exploration and biographies. From printed sources of information one may be tempted to original sources where one is confronted with the need for a variety of foreign languages and ability to read different kinds of writing (palæography). To impose any such burdens as the above on the average undergraduate is obviously impossible, and in the few pages which follow one can only outline this branch of pharmacognosy which like other aspects of pharmaceutical history deserves much more study than it has hitherto received. Pharmaceutical history has general educational value but the amount which can be incorporated in most pharmaceutical courses is rigidly limited by the time available. It is hoped, however, that some students will return to historical studies after graduation either to obtain higher degrees or as a hobby which is particularly suited to a practising pharmacist.

The articles and books mentioned at the end of this chapter provide starting points for further reading. Some of these are admittedly learned tomes but others such as Dewhurst's *The Quicksilver Doctor* or Elgood's *A Medical History of Persia* would rank as pleasant armchair reading for a wide variety of readers.

I am very conscious that when writing on ancient civilisations it is extremely difficult to give an unbiased account and

one can easily either over-emphasise or under-emphasise their scientific achievements. One must constantly bear in mind that the philosophy of the ancients was very different from that of our present technological age and that we are often making our judgements on very incomplete evidence. Only a fraction of the ancient manuscripts have survived, and these often in texts which have probably suffered in accuracy by deletions and additions made by the various scribes copying and recopying often centuries after the time of the author. Again many such texts have come down to us not in their original language but after one or more translations. For example, the works of many of the ancient Greek and Latin authors were preserved in various languages in the Middle East, reached Europe particularly during the thirteenth century in Arabic, and were then translated into Latin. Frequently the Greek into Arabic translation was well done, but errors crept in when the Arabic was turned into Latin. Bearing such facts in mind we now consider some of the main periods and personalities. The men with whom we are concerned vary in race and importance and include not only medical and pharmaceutical authors, but patrons such as Alexander the Great and Harun-al-Rashid ; translators such as Constantine the African and Gerard of Cremona ; travellers and explorers such as Marco Polo, Ibn Batutah and Livingstone.

Folk Medicine

The scientific screening of drugs for possible medicinal activity is a very recent development and therefore virtually all the drugs now in common use were discovered by a process of trial and error. At a very early stage in his development man separated those plants which were good for food, or useful to him in other ways, from those that were poisonous. This knowledge of plants or " wortcunning " provided him with the first drugs of his materia medica and there are, of course, primitive tribes to this day living at this stage of development. The reasons for the effects noted were naturally not understood and wortcunning inevitably became associated with magic and religion, and medical practice became the province of witch-doctors, priests and eventually physicians.

Looking back after thousands of years we must not despise this trial and error method. Not only did it lead to the effective distinction between poisonous plants and those fit for food but to the discovery of other properties such as the preparation

of drinks by alcoholic fermentation, the preparation of fixed oils, the preservative action of spices and the removal of prussic acid from cassava to render it safe as a foodstuff. In widely different parts of the world man discovered that stimulating drinks could be prepared from tea, coffee, cocoa, cola, guarana and maté at least a thousand years before it was known that these all contain the related bases, caffeine and theobromine.

A materia medica evolved by primitive man tends to be limited to drugs whose action is evident but not dangerous. This applies, for example, to herbs used for flavouring, purging, expelling worms or killing lice, and drugs of these types occur in the earliest medical records. For example, the *Papyrus Ebers* of about 1600 B.C. refers to the tape-worm remedy, pomegranate root bark, which is still in use today in the form of its active constituents Pelleterine Tannate. Very potent products on the other hand, such as those used for arrow poisons, were unsuitable for medical use until recent times when it became possible to standardise them and use accurate doses of their active ingredients. Thus we now use strophanthin and tubocurarine, derived respectively from African and South American arrow-poisons.

Many folk remedies, although not included in modern pharmacopœias, are still widely used and in the absence of more scientific examination than some of them have so far received we cannot ignore the possibility that some may repay further investigation. It may be remembered that until about 1942 rauwolfia was an Indian folk remedy virtually unknown to western medicine although it had been used in India from time immemorial.

Ignoring the medical history of the Far East we consider first the great river-valley civilisations of Egypt and Mesopotamia. Then, following a more or less chronological order we turn to classical Greece and Rome, Islam and Western Europe.

Egypt

3000–1600 B.C.—Although Egyptian history may be traced to about 4000 B.C. we need consider only a relatively short period beginning about 2000 B.C. By this time a high degree of civilisation had been attained. The pyramids were already old, an alphabet of pictorial signs and a good writing material from the papyrus reed had been developed. Scribes wrote with an ink made of water, gum and soot.

Egyptian medicine was primitive in the sense that it was composed of magic, religious and empirical elements. Among the many papyrus fragments which have survived are some dated about 1900 B.C. which deal with veterinary medicine and with gynæcology. Two much larger papyri, which both date from about 1600 B.C., are the *Papyrus Edwin Smith* and the *Papyrus Ebers*. The former deals mainly with surgery, particularly wounds received in war, whilst the latter is a collection of books dealing mainly with internal diseases and giving a large number of recipes. Whilst many drugs were used in ancient Egypt it is often difficult to identify them for reasons which Sigerist explains as follows :—" The interpretation of Egyptian prescriptions and the identification of drugs present considerable difficulties. The name of a plant is meaningless unless it has survived in the Coptic and possibly in the Arabic or some other Semitic language. Sometimes the hieroglyphic determinative points out whether the drug is a leaf, a root, a tree, a gum, or some similar part of a plant. But even when we are able to translate the ingredients of a recipe we are never quite sure that the literal rendering gives the correct meaning. ' Ass's head ' and ' pig's tooth,' which occur in recipes of *Papyrus Ebers* may well be what the name implies, but not necessarily so ; just as in our language buttercups are not necessarily receptacles for butter and snapdragons are not wild animals."

Much of the vegetable materia medica of Egypt consisted of indigenous plants but some, such as cassia bark, were imported. Of those which remain in present day commerce may be mentioned myrrh, frankincense, storax, benzoin, crude turpentine, linseed, mustard, various umbelliferous fruits, saffron, acacia gum, colocynth, senna and castor oil. Animal products were less important and less numerous than vegetable ones, but included a wide range of fats and milks which were used as vehicles, and the livers, brains, blood and dung of a variety of animals. Drugs of mineral origin were fewer in number, but included various copper salts (*e.g.* malachite or native carbonate), stibnite (antimony sulphide), the ferruginous earths (red and yellow ochre), alum and the powder of certain minerals such as alabaster and lapis lazuli.

Mesopotamia

Sumeria 3000–2400 B.C.—Mesopotamia and Egypt both entered the historical period about 4000 B.C. but the history of

Mesopotamia is more complicated because it involves many different races and its boundaries fluctuated widely. The Sumerians ruling from Ur developed a high civilisation particularly notable for its irrigation systems. They had at first a pictorial script like that of the Egyptians and later developed a cuneiform script which was used to write on clay tablets. These when baked gave very permanent records. About 2400 B.C. the Sumerians were defeated by Sargon, the first ruler of a Semitic Empire which extended from the Persian Gulf to the Mediterranean.

Babylon ca. 2025 B.C.—About 2025 B.C. Mesopotamia was invaded from the East by the Elamites and from the west by the Amorites. The latter developed Babylon from a very small town to the capital of an Empire. Hammurabi, the greatest Amorite king, not only defeated the Elamites but attracted many scholars to his court. Books on medicine were written and translated and from the famous Hammurabi Code of Laws we learn much of social conditions. Large numbers of cuneiform tablets have survived from this and later periods, but as Sigerist points out the dating of these often presents great difficulty. This period of Babylonian history was brought to an end by invading tribes of Hittites and Kassites and was followed by about a thousand years of decay and stagnation.

Assyria ca. 1900 to 612 B.C.—The Assyrians were a virile nation of merchants, warriors and colonisers whose armies, the first to be fully armed with iron weapons, spread from north-eastern Mesopotamia in every direction. Their capital city was Nineveh and they became the dominant power in the Near East, particularly in the period 750 to 612 B.C. King Sennacherib (705–681), who sacked Babylon, is credited with the introduction of the cotton plant from India. King Esarhaddon and his son Ashurbanipal (668–626) conquered Egypt. The latter's library at Nineveh has provided much knowledge of the Assyrians since its excavation disclosed some 22,000 clay tablets which are now in the British Museum. Some 660 of these which refer to drugs are mentioned below. Assyria in its turn fell to invaders, and Nineveh was destroyed in 612 B.C.

Chaldea ca. 612–561 B.C.—On the death of Ashurbanipal the power of the Assyrians was broken by the Medes and the Chaldeans. The latter, a Semitic tribe, immediately occupied Babylon and their later conquests included the destruction of Jerusalem in 586 B.C. when many Jews were taken to Babylon. King Nebuchadnezzar (604–561) rebuilt his capital making its

" hanging gardens " one of the wonders of the ancient world. The weak king who followed him soon had to face a growing Persia.

As might be expected from the fact that Egyptian and Mesopotamian civilisations flourished together and that there was much trade between them their materia medicas have much in common. The magic and religious elements of medicine seem to have been stronger in Mesopotamia than in Egypt. The results of the examination of some 660 cuneiform tablets have been reported by R. Campbell Thomson in *The Assyrian Herbal.* Excluding materials used as vehicles, he lists some 250 medicinal plants and vegetable drugs, 120 mineral substances and about 180 animal and unidentified drugs. Among those in frequent use were Indian hemp, opium, pine oleoresin, rose, storax, galbanum, vegetable alkali, myrrh, asafetida, mint, fennel, liquorice, linseed and mandragora. Some identifications are obviously somewhat doubtful but others seem quite definite. For example, a plant which yields a fibre used for weaving and also a potent " drug for sorrow " is obviously the hemp plant, *Cannabis sativa.* Similarly, the " cucumber of the desert which is like a ball," is colocynth. A description of the preparation of opium differs little from that of a modern text-book :— " Early in the morning old women, boys and girls collect the juice by scraping it off the wounds with a small iron scoop and deposit the whole in an earthen pot."

Persia and Greece

Whilst the great period of Greek science and medicine was yet to come the early temple medicine is not without interest although the use of drugs was of secondary importance. Æsculapius, later venerated as the god of medicine, may have been an actual man who lived about 1250 B.C. at Delphi. At many of the temples the sick were subjected to " temple sleep," which may be regarded as a form of psychotherapy, but cures were also assisted by diet, bathing and exercise.

When thinking of ancient Greece and Persia we must forget their present frontiers. Between about 650 and 525 B.C. Persian kings, such as Cyrus the Great and Darius, had conquered not only Mesopotamia, part of the Indian subcontinent, Egypt and Asia Minor but had penetrated into Europe. Thus in 512 B.C. the Greeks and Persians had a common frontier in Scythia, Thrace and Macedonia. The Persian kings employed