



# Textbook of Pharmacology

B. C. BOSE, M.D., D.SC., F.A.M.S.

Ex-Dean & Professor of Pharmacology,  
Emeritus Scientist, Professor Emeritus  
M.G.M. Medical College, Indore (M.P.)

SCIENTIFIC BOOK AGENCY

22 RAJA WOODMUNT STREET

CALCUTTA 1

*ALL RIGHTS RESERVED*

*First Published 1975*

PUBLISHED BY J. SINHA, SCIENTIFIC BOOK AGENCY, 22 RAJA WOODMUNT STREET, CALCUTTA 1 AND PRINTED BY DEBDAS NATH, SADHANA PRESS PRIVATE LIMITED, 76 BEHIN/BEHARI GANGULI STREET, CALCUTTA 12

## CONTENTS

<i>Preface</i>	v
----------------	---

### SECTION I

#### *GENERAL PHARMACOLOGY*

1. SCIENCE OF PHARMACOLOGY—Evolution, Relation and Scope.	...	1
2. DRUGS—Some Fundamental aspects: Source, Active principles, Preparation, Quality control.	...	23
3. MODE OF ADMINISTRATION AND FATE OF DRUGS—Routes of Administration, Metabolism and Biotransformation.	...	42
4. CELLULAR PHARMACOLOGY—NATURE AND MECHANISM OF DRUG ACTION—Cell-Drug action at Molecular levels: Salt and Ionic action, SAR, Substrate competition, Biological antagonism, Chelation, Antimetabolite action.	...	52
5. FACTORS MODIFYING DRUG ACTION. (a) The Stimulus-Dose, Route, Drug combination and incompatibility. (b) The Responding System—age, sex, body weight, physiological status and cellular response.	...	72

### SECTION II

#### *BIOASSAY AND GENETIC PHARMACOLOGY*

6. EVALUATION AND ASSAY OF DRUG—General Principles. Standards, Types of Assay. Biological Variation. Biometry. Individual Assay methods.	...	87
7. CONCEPT AND SCOPE OF PHARMACOGENETICS—Fundamental aspects. Chromosomal aberration. Drug and Gene induced disorders. Drug responses in Man and Animal.		104

### SECTION III

#### *PHARMACOLOGY OF AUTONOMIC DRUGS*

8. GENERAL CONSIDERATIONS—Somatic and Autonomic Nerves. Physio-anatomical considerations. Chemical mediation and Receptors.	...	113
-----------------------------------------------------------------------------------------------------------------------------	-----	-----

9. **PARASYMPATHOMIMETIC DRUGS**—Classification. Muscarnic, Nicotinic and Irreversible anticholinesterase actions. Diazinol poisoning. Therapeutic considerations.... 123
10. **PARASYMPATHETIC BLOCKING AGENTS**—The solanaceae Alkaloids—atropine and hyoscine. Atropine derivatives and substitutes. ... 139
11. **SYMPATHOMIMETIC DRUGS**—Natural and Synthetic agents; SAR; Actions and therapeutic status. ... 149
12. **ADRENERGIC BLOCKING AGENTS**—Receptor blockade and sympatholytic action. Ergot and Synthetic compounds. ... 162
13. **GANGLION BLOCKING AGENTS**—Natural and Synthetic compounds. Mechanism of action. Therapeutic status and limitations. ... 169
14. **NEUROMUSCULAR BLOCKING AGENTS—MUSCLE RELAXANTS**—Physiology of N. M. transmission. Classification, Toxicity and Uses of drugs. ... 177

#### SECTION IV

##### *LOCAL HORMONES, HISTAMINE AND ANTIHISTAMINICS*

15. **LOCAL HORMONES**—5-HT, GABA, BRADYKININ—Definition and role. ... 189
16. **HISTAMINE, ANTIHISTAMINE AND ANTIALLERGIC DRUGS**—Concepts of allergy. Chemical nature. Mechanism of action. Therapeutic status of Antihistaminic drugs. ... 195

#### SECTION V

##### *CENTRAL AND PERIPHERAL NERVOUS SYSTEM*

17. **GENERAL CONSIDERATIONS**—Divisions. Types. Methods of study. ... 210
18. **STIMULANTS OF THE CENTRAL NERVOUS SYSTEM—ANAESTHETICS**. Medullary, Spinal, Cerebral Stimulants and Coagulants. Therapeutic limitations. ... 220
19. **PHARMACOLOGY OF ANAESTHETICS**—Principal Types—General and Local. Adjuvants to General Anaesthetics. Refrigeration Anaesthesia. ... 229

20.	PHARMACOLOGY OF LOCAL ANAESTHETICS— General Properties. Types. Modes of study and Clinical status. ...	252
21.	PSYCHOPHARMACOLOGY — Physiopharmacological Considerations. Scope and status. ...	263
22.	SEDATIVES, HYPNOTICS AND ANTICONVULSANT DRUGS—Selective and Nonselective actions. Chemical nature. Toxicity. Addiction liabilities. ...	275
23.	EPILEPSY AND ANTIEPILEPTIC DRUGS—Recent advances. Drug therapy and limitations. ...	287
24.	PHARMACOLOGY OF VOMITING—Physio-pharma- cological concepts. Vomiting centres. Chemoreceptor Trigger Zone. Motion sickness. Mechanisms of action of Emetic and Antiemetic drugs. ...	300
25.	PHARMACOLOGY OF HABIT FORMING DRUGS— ETHANOL, OPIUM ALKALOIDS AND SUBSTITUTES —Problem of Drug Addiction. Management. ...	306
26.	PHARMACOLOGICAL RESPONSES OF THE RES- PIRATORY SYSTEM—Physio-pharmacological Consi- derations: O <sub>2</sub> and CO <sub>2</sub> Cases. Anti-tussive and Expectorant Drugs. ...	327
27.	PHARMACOLOGY OF ANALGESIC-ANTIPYRE- TICS—Antirheumatic, Antiarthritic, Antigout and General antipyretic agents; Mechanism of action, Toxicity and Therapeutic status. ...	341

## SECTION VI

*CARDIOVASCULAR SYSTEM, BLOOD AND  
BLOOD FORMING ORGANS*

28.	GENERAL CONSIDERATIONS—Properties of Cardiac muscles, Autonomic control. Cardiac reserve, Circus move- ment. Heart failure. ...	364
29.	DRUGS ACTING ON THE HEART—Cardiac Glycosides and Antiarrhythmic Drugs—Scope of action and uses. ...	374
30.	PHARMACOLOGY OF BLOOD VESSELS—Vasocon- strictors. Vaso and Coronary dilators, Antihypertensive and Antiatherosclerotic Agents. ...	398

31. DRUGS ACTING ON BLOOD AND BLOOD FORMING ORGANS—Haematinics. Drugs stimulating and depressing R. B. C. and W. B. C. formation. Coagulants, Anticoagulants, Sclerosing and Fibrinolytic Agents. ... 421

## SECTION VII

*BODY FLUIDS, IONS, METALS, METAL ANTAGONISTS AND RADIOISOTOPES*

32. BODY FLUIDS, IONS AND BLOOD SUBSTITUTES—  
—Water Balance, Composition and Distribution. Buffering System. Acid-base Balance. Acidosis and Alkalosis. Dehydration, Water intoxication. Parenteral fluid therapy... 452
33. PHARMACOLOGY OF CATIONS AND ANIONS—  
Ions of alkali metals. Acids and Salts—sodium, potassium, ammonium, magnesium and calcium: Inorganic acids and salts, Actions and Uses. ... 465
34. METALS, METAL ANTAGONISTS AND RADIOISOTOPES—Scope and limitations. Metalloids. Role of Radioisotopes in Curative and Experimental Medicine. ... 480

## SECTION VIII

*EXCRETORY AND REPRODUCTIVE SYSTEMS*

35. PHARMACOLOGY OF DIURETICS—Renal Function. Physiopathology of Oedema. Diuretics. Mode of action and Status. ... 500
36. PHARMACOLOGY OF REPRODUCTIVE SYSTEM AND ACCESSORY ORGANS—Physio-anatomical Considerations. Endocrine control. Oxytocics, Abortifacients and Uterine Sedatives. Galactogogues and Antigalactogogues. ... 530

## SECTION IX

*PHARMACOLOGY OF THE DIGESTIVE SYSTEM*

37. GENERAL CONSIDERATIONS OF THE G. I. TRACT—  
—Physio-pathological Aspects. Common disorders. Scope of Drug therapy. ... 544

38. PHARMACOLOGIC RESPONSES IN MISCELLANEOUS G. I. DISORDERS—Sialogogues. Stomachics. Digestants. Carminatives. Adsorbant and Nutrients; Liver poisons and Protectives. Treatment of Dyspepsia and Hepatic Failure. ... 551
39. PHARMACOLOGIC RESPONSES IN GASTRIC ACIDITY AND PLAIN MUSCLE SPASMS—Antacids; Antisecretory and Antispasmodic Agents. Role in Peptic Ulcer and Colicky Pains. ... 568
40. DRUGS AFFECTING THE MOVEMENTS OF THE BOWELS—Purgatives, Laxatives, Astringents and Intestinal sedatives. ... 579
41. PHARMACOLOGY OF ANTHELMINTIC DRUGS—Intestinal and Tissue Forms. Life Cycle. Modes of infestation. Status of Drug therapy in Intestinal Helminthiasis. ... 596

## SECTION X

*CHEMO AND ANTIBIOTIC THERAPY*

42. PHARMACOLOGY OF ANTI-INFECTIVE DRUGS—General Considerations; Historical Background. Specificity of Action; Mode of study. Problems of Toxicity and Resistance formation. ... 608
43. CHEMOTHERAPY OF SYPHILIS—Major and Minor Relative Specificity. Toxicity and Therapeutic Status. Symptomatic and Biological cure of Syphilis. ... 617
44. CHEMOTHERAPY OF PROTOZOAL AND OTHER PARASITIC DISEASES—Pharmacology of—(a) Malaria (b) Amoebiasis (c) Leishmaniasis (d) Trypanosomes (e) Filaria (f) Schistosomes (g) Spirochaetes (h) Rickettsia and other infections, Modes of Transmission. Status of Drug Therapy. ... 630
45. ANTIBACTERIAL CHEMOTHERAPY—(a) Sulphonamides and (b) Antibiotics. Development, Scope and Status of Sulphonamides. ... 655
46. PHARMACOLOGY OF ANTIBIOTICS—General Considerations. Definition, Sources and Classification. Mode and Spectrum of Action. Uses. ... 669



47. CHEMOTHERAPY OF TUBERCULOSIS, LEPROSY AND URINARY TRACT INFECTIONS—Chemo and Antibiotic therapy of tuberculosis and leprosy. Achievements and limitations. Drug Resistance. Urinary Tract infections and its management. ... 699
48. CHEMOTHERAPY OF MALIGNANCY OF BLOOD AND OTHER TISSUES—Physiochemical Consideration of Cell; Drugs used in Blood and Tissues malignancies. Mechanisms of Action and Status. ... 718
49. PHARMACOLOGY OF LOCAL ANTISEPTICS AND DISINFECTANTS—Definition and Scope. Mode of Study. Status and limitations. ... 722
50. PHARMACOLOGY OF IMMUNITY AND IMMUNOSUPPRESSIVE AGENTS—Immunological Response. Active, Passive, Primary, Secondary, Hypersensitivity Reactions. Vaccines, Sera, Phages and Gamma globulin, Immunosuppressive Agents in Surgery. Autoimmune Diseases.... 749

## SECTION XI

### *VITAMINS, HORMONES AND ANTIFERTILITY AGENTS*

51. PHARMACOLOGY OF VITAMINS—Fat and Water soluble Vitamins. Role in Diseases. Actions and Uses. ... 765
52. PHARMACOLOGY OF ENDOCRINES—General considerations. Interrelation of Hormonal Control. Mode of Study. Deficiency and hypersecretion Syndromes. Hormone Antagonists. ... 785
53. PHARMACOLOGY OF PROTEIN HORMONES—Pituitary, Thyroid, Parathyroid and Pancreatic hormones. Chemical nature, Pharmacological action and Status. ... 796
54. PHARMACOLOGY OF STEROID HORMONES—Cortical, Testicular and Ovarian Hormones. Chemical nature. Actions and Therapeutic Status. ... 833
55. CONTRACEPTIVE AND ANTIFERTILITY AGENTS—Population Explosion. Need of Family Planning in Underdeveloped Countries. Various Measures of Contraception. Scope and limitations of Antifertility Agents. ... 851

## SECTION XII

## MISCELLANEOUS AGENTS

56. PHARMACOLOGY OF MISCELLANEOUS THERAPEUTIC AND DIAGNOSTIC AIDS—(a) Irritants, counterirritants, caustics, keratolytics, melanising and demelanising agents. (b) Noxious gases, (c) Diagnostic Aids (d) Indigenous Medicinal Plants. ... 860

*Appendix*—Forensic Pharmacy, Selected Prescriptions and Questions ... 887

*Index*

## PLATES

I	Some Early Pioneers.	...	...	...	5
II	Foundation of Scientific Anatomy, Physiology and Pharmacology	...	...	...	10
III	Foundation of Anaesthesiology, Bacteriology and Antisepsis.	...	...	...	13
IV	Some Earlier Architects of Modern Pharmacology.	...	...	...	16
V	Some of the Important Basic Nuclei.	...	...	...	33
VI	Quantitative Pharmacology and Discovery of Specific Therapy.	...	...	...	85
VII	Important Participants in the First International Meeting on Biological Standardisation at Geneva.	...	...	...	86
VIII	Anatomical Distribution of Autonomic Nerves.	...	...	...	115
IX	Transmission of Impulses in Autonomic and Motor Nerves.	...	...	...	118
X	Plants Containing Autonomically Active Principles.	...	...	...	124
XI	Tissue Responses to Cholinomimetic and Cholinolytic Drugs.	...	...	...	126
XII	Structure of Anticholinergic Drugs.	...	...	...	140
XII(a)	Chemical Nature of Sympathomimetic Drugs	...	...	...	152
XIII	Sympathomimetic Actions of Adrenaline.	...	...	...	154
XIV	Action of Ganglion Blocking Agents.	...	...	...	170
XV	Neuromuscular Junction and Transmission of Impulses.	...	...	...	179
XVI	Bovet and Antihistaminics.	...	...	...	194
XVII	Some Centrally Acting Medicinal Plants.	...	...	...	218
XVIII	Effect of Analeptics on Blood Pressure and Respiration.	...	...	...	219
XIX	Action of General Anaesthetics on Cardiovascular System.	...	...	...	236
XX	Local Anaesthetics—Structure and Site of Action.	...	...	...	253
XXI	E.E.G. Pattern in Epilepsies and Chemistry of Anticonvulsants.	...	...	...	288

XXII	Structural Formulae of Important Morphine Derivatives and Substitutes.	...	...	...	316
XXIII	Effect on Respiration—Morphine and Nalorphine.	...	...	...	317
XXIV	Heat Regulation and Antipyretic Drugs.	...	...	...	343
XXV	Uric Acid Metabolism and Antigout Drugs.	...	...	...	344
XXVI	Physiology of Heart and Genesis of Atrial Fibrillation....	...	...	...	365
XXVII	William Withering and Cardiac Glycosides.	...	...	...	376
XXVIII	Structure and Action of Cardiac Drugs.	...	...	...	377
XXIX	Erythropoiesis and Haematinics.	...	...	...	423
XXX	Structure of Haematinic Principles, Coagulant and Anticoagulants.	...	...	...	425
XXXI	Regulation of Calcium Metabolism.	...	...	...	472
XXXII	Pharmacologic Responses of Plain Muscles to Different Groups of Drugs.	...	...	...	538
XXXIII	Diagrammatic Representation of Common Intestinal Parasites and Drugs Effective Against Them.	...	...	...	598
XXXIV	Pioneers of Anti Infective Therapy.	...	...	...	609
XXXV	Life Cycle of Plasmodium Vivax and Site of Action of Antimalarial Drugs.	...	...	...	628
XXXVI	Chemical Structure of Antimalarial Drugs.	...	...	...	629
XXXVII	Common Pathogenic Protozoa and Spirochaetes.	...	...	...	643
XXXVIII	Some Common Bacteria.	...	Facing	...	668
XXXIX	Fungi of Medicinal Importance.	...	...	...	671
XL	Structure of Some Antibiotics.	...	...	...	675
XLI	Blood Picture in Different Types of Leukaemia.	...	Facing	...	722
XLII	Chemical Structure of Vitamins.	...	...	...	768
XLIII	Some Pioneer Endocrinologists.	...	...	...	788
XLIII(a)	Inter-relation of Hormonal Control	...	...	...	791
XLIV	Mechanism of Synthesis and Secretion of Thyroid Hormones and Sites of Action of Antithyroid Drugs.	...	...	...	805
XLV	Mechanism of Action of Counterirritants.	...	...	...	867

## SECTION

### I

## GENERAL PHARMACOLOGY

### CHAPTER

#### .1

## SCIENCE OF PHARMACOLOGY

### (EVOLUTION, RELATION AND SCOPE)

[Man's inquisitiveness for understanding the mysteries of nature, from which science and medicine have developed, must have been as old as life itself on the planet. It is believed that the homosapiens or the first race of 'ape-man' might have lived about  $10^6$ , the second race about  $10^5$  and the third race about 50,000 B.C. The concepts of 'Gods' and 'Demons' might have appeared in the neolithic period only. The primitive man hurt by an 'external foe' dealt with him physically. When afflicted by an illness, he took it to be the mischief of an 'internal foe' or 'demon' whom he tried to get rid of by placation or trephining. The mother found her baby unwell and applied a cold sponge for its relief. These thus were the starting points of medical, surgical and nursing cares in the prehistoric days. It was much later, that, when in search of food, he found out poisonous plants and used them against diseases and foes.

The earliest records of medical practice are traceable in Sumarian, Persian, Egyptian, Chinese and Indian systems. Though some of them had attained a good stature in medical, surgical and Public Health measures, modern medicine started from the Greco-Roman School with Hippocrates, Dioscorides and Galen, between 4th century B.C. to 2nd century A.D. Then followed a long period of over 1,000 years of 'Middle' or 'dark age' during which, the dogmatic teachings of Galen along with 'Arab alchemy', prevailed. Renaissance in medicine, started with Paracelsus in the 15th century A.D., followed by methodical studies of anatomy, physiology, mathematics, physics and chemistry. Nevertheless, progress was still very slow in the 17th and 18th centuries and scientific advances in medicine, started mostly in the 19th century, by which time, pure and basic medical sciences had sufficiently advanced.

Pharmacology like biochemistry, needed the prior development of chemistry and physiology for its scientific advancement. From the beginning of the last century, plant constituents were isolated and studied by animal experimentations with the help of gradually developed physiological techniques and instruments. The work was further facilitated by the discovery of hypodermic needle in the middle of the last century. The initial works of Magendie, Claude Bernard, Ludwig, Buchheim, Schmiedberg, Abel, Dixon and Cushny are of special significance in establishing the science of pharmacology on the sound footing. Towards the latter part of the last and the first half of the present century, with remarkable advances in biochemistry, drug synthesis, microbiology, knowledge of vitamins and hormones, it became

possible to understand the quantitative and cellular nature of drug action, which gradually led to the introduction of chemo and specific therapies, which are now eclipsing all other methods of treatment of diseases in the present era.

The subject of pharmacology comprises of pharmacognosy, pharmaceuticals, pharmacodynamics, toxicology, bioassay and therapeutics. It is interrelated with botany, chemistry, physiology and biochemistry on the one hand and with pathology, microbiology, medicine and therapeutics on the other. Its scope has much increased during the last fifty years and it is being oriented more towards specific therapies, in all directions, including systemic, infective, malignancy, immunosuppressive, genetic and fertility problems, with more or less selective actions.]

Use of drugs is as old as diseases. In the earlier days, mostly herbal and chemical drugs were in empirical use and the subject providing relevant information about these drugs was known as *materia medica*. At a later stage, due to the advancement of basic sciences, knowledge of diseases and of experimental techniques, scientific study of drug action was possible. Since then the subject is known as *pharmacology* or the science of drugs.

Due to the advancement of physiology, biochemistry and allied disciplines, this new branch of medicine has developed beyond all proportions during the last one century, so much so that at present, not only drug action in many cases has been established on scientific and quantitative basis but their sites of action, metabolism actions at cellular or enzymatic levels, intricate mechanisms subscribing to the specificity of action as in the cases of chemotherapeutic, antibiotic, vitamins, hormones and other specific drugs have also been determined.

In the light of all these advances, it is now possible to consider and study the subject under the following aspects :

- (1) General pharmacology,
- (2) Special pharmacology,
- (3) Systemic pharmacology.

## EVOLUTION

The history of pharmacology is intimately connected up with that of medicine. Struggle for health, struggle against illnesses and struggle for immortality have always been the fanciful dreams of human minds. History of medicine and drugs is thus traceable through different periods of growth of civilization, viz. (a) prehistoric era, (b) earlier periods, (c) middle ages, (d) renaissance, (e) medicine and pharmacology of modern times.

## SECTION

### I

## GENERAL PHARMACOLOGY

### CHAPTER

#### 1

## SCIENCE OF PHARMACOLOGY

### (EVOLUTION, RELATION AND SCOPE)

[Man's inquisitiveness for understanding the mysteries of nature, from which science and medicine have developed, must have been as old as life itself on the planet. It is believed that the hominids or the first race of 'ape-man' might have lived about  $10^6$ , the second race about  $10^5$  and the third race about 50,000 B.C. The concepts of 'Gods' and 'Demons' might have appeared in the neolithic period only. The primitive man hurt by an 'external foe' dealt with him physically. When afflicted by an illness, he took it to be the mischief of an 'internal foe' or 'demon' whom he tried to get rid of by placation or trephining. The mother found her baby unwell and applied a cold sponge for its relief. These thus were the starting points of medical, surgical and nursing cares in the prehistoric days. It was much later, that, when in search of food, he found out poisonous plants and used them against diseases and foes.]

The earliest records of medical practice are traceable in Sumarian, Persian, Egyptian, Chinese and Indian systems. Though some of them had attained a good stature in medical, surgical and Public Health measures, modern medicine started from the Greco-Roman School with Hippocrates, Dioscorides and Galen, between 4th century B.C. to 2nd century A.D. Then followed a long period of over 1,000 years of 'Middle' or 'dark age' during which, the dogmatic teachings of Galen along with 'Arab alchemy', prevailed. Renaissance in medicine, started with Paracelsus in the 15th century A.D., followed by methodical studies of anatomy, physiology, mathematics, physics and chemistry. Nevertheless, progress was still very slow in the 17th and 18th centuries and scientific advances in medicine, started mostly in the 19th century, by which time, pure and basic medical sciences had sufficiently advanced.

Pharmacology like biochemistry, needed the prior development of chemistry and physiology for its scientific advancement. From the beginning of the last century, plant constituents were isolated and studied by animal experimentations with the help of gradually developed physiological techniques and instruments. The work was further facilitated by the discovery of hypodermic needle in the middle of the last century. The initial works of Magendie, Claude Bernard, Ludwig, Buchheim, Schmiedberg, Abel, Dixon and Cushny are of special significance in establishing the science of pharmacology on the sound footing. Towards the latter part of the last and the first half of the present century, with remarkable advances in biochemistry, drug synthesis, microbiology, knowledge of vitamins and hormones, it became

features in *Nidan* and other treatises of Ayurvedic medicine are as follows :

- (a) *Theory of Tridosha* referring to the imbalance in 'vayu', 'pitta' and 'kapha', causing various disorders, which are reflected on the radial pulse and the diagnosis of diseases made therefrom. This is known as the '*science of pulse*'.
- (b) Monumental work, for those days, in medicine and surgery, as embodied in *Susruta* and *Charak*, compiled about 1000 B.C., the former dealing with surgery and the latter with internal medicine.
- (c) A beautiful *Materia Medica* embodying '*Dravyaguna*' and descriptions of 107 medicinal plants and inorganic chemicals.
- (d) Knowledge of hygiene and public health, as contained in *Manu Sanghita*.
- (e) Use of '*Sammohini*' as an anaesthetic in the Buddhist period.
- (f) Description of tuberculosis, infectious diseases, malaria, leprosy and practice of couching and trephining operations are found in these records.

This ancient medicine, however progressive in those days, could not be claimed to be scientific. Any attempt to integrate it with modern medicine would, therefore, fail as the basic concepts are not scientifically tenable. It is true that some amount of scientific researches on the chemico-pharmaco-therapeutic values of some of these ancient drugs could be carried out but in the light of experience already gained, it is for consideration whether this study should have the priority, as is being given to it in our country at present.

**Greco-Roman School:** This laid the real foundation of modern scientific medicine. *Aesculapius* (1143 B.C.), known as the son of *Appollo*, and his daughter, *Hygeia*, can be considered to be the earliest recorded figures. He was so famous in his time that he, it is alleged was slain by *Zeus* with the apprehension that he might render all men immortal. To him, we owe the knowledge of the tonic properties of iron and the '*medical emblem*' of the '*Snake and the Wand*'.

*Hippocrates* (460-400 B.C.) is the father of modern medicine. Before him, medicine was a curious blend of mystic philosophy and predestined observations. It was the genius of Hippocrates to make it rational, ethical and an objective study. His contributions pervaded practically all aspects of medical science, public health and medical ethics. Diseases like tuberculosis, tetanus, epilepsy, hysteria and many others were masterly described by him and similarly, a large number

# Plate I

## SOME EARLY PIONEERS



FIG. 1. *Aesculapius* (1143 B.C.). A mythical figure ; son of Apollo and endowed with the secret of immortality. The medical emblem, 'Snake and Wand' comes from him.



FIG. 3. *Dioscorides* (A.D.56) Author of *De Universa Medicina* and the first to systematise knowledge of 800 medicinal plants.



FIG. 2. *Hippocrates* (360—400 B.C.). Undoubted founder of modern medicine, who advocated objective study and left sermons and hippocratic collections behind him.



FIG. 4. *Galen* (130—200 A.D.). A supreme authority, whose doctrine and dogma remained unchallenged upto the 15th century. His polypharmacy and galenical preparations are still known.



FIG. 5. *Paracelsus* (1493—1541 A.D.). Rightly named as 'Luther of Medicine', who strongly decried Galen's dogmatic teachings, spared Hippocrates and advocated chemical study of diseases and medicines. He brought renaissance in medicine.



of drugs—opium, hyoscyamus, scilla and cantharis, to cite a few only, were studied and used. His method of treatment was simple—‘*vis medicatrix*’ or nature cure advocating the value of pure air, dietetic treatment, use of simple purgatives and cholagogues or drugs increasing excretion of bile. Hippocrates was also a saintly man and his ethical rules for the profession embodied in the *Sermons of Hippocrates*, are ostentatiously followed even today. More than 100 books, collectively known as *Hippocratic Collections* or *Corpus* were written by him or probably by his school. His school, however, was weak in theory, but strong advocates of observations, which was partially responsible for bringing the dogmatic Roman School of Galen at a later stage. It may be noted that Aristotle (384-322 B.C.) applied Hippocratic methods of observations in his study of general sciences.

**School of Alexandria :** With Herophili, as its central figure, it initiated some anatomical studies during this period. *Dioscorides* (A.D. 56) who belonged to the Roman School of Medicine contributed a good deal in therapeutics. He compiled the first extensive *Materia Medica* and described individual crude drugs—vegetable, animal and minerals used in medicine, in alphabetical orders. He also described their methods of preparation, administration and therapeutic values.

In his monumental work *De Universa Medicina*, he incorporated about 800 vegetable and 90 mineral remedies : (a) aromatic plants, (b) organotherapeutic remedies, (c) aloes and scammony as purgatives, (d) male fern for worms, (e) sulphur in pulmonary disease, and (f) castor oil as purgative. He had travelled extensively with the army of *Nero* and collected newer drugs from other countries, which he systematically arranged and described. The *Doctrine of Signature*, i.e. one medicine for one disease, which had further developed during this period, could be considered to be the starting point of pharmacognosy or identification of drugs of today.

*Galen* (A.D. 130-200) belonged to the Roman School of Medicine and was considered to be the supreme authority in medicine and pharmacy for nearly 15 centuries. He was the last scholar of the Alexandrian School and undoubtedly the most prominent figure after Hippocrates. Though his name in Greek meant calm, he was a man of great dynamism and drive and also vain and sophisticated. Unlike Hippocratic teachings which stressed observations and not theories, Galen's teachings were rich in theories and dogmas and had thus an initial appeal to the profession.