HANDBOOK OF Pharmaceutical and Clinical Measurement and Analysis

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PREFACE

This text is equipment oriented and is meant especially for use by technical personnel associated with the clinical pharmaceutical regime. Essentially the text covers the details of measurement and identification on drugs, medicine, or bodily compounds. The background material necessarily includes explanatory sections dealing with the basics of organic and inorganic chemistry; it is, however, mainly electronic and mechanical in nature.

Consequently, early chapters outline a generalized technical measurement approach applying to drug assay and clinical analysis although some attention is given to the basics of "wet" chemical analysis and clinical measurements.

More specifically, however, the later chapters of this text consist of hardware and operational descriptions and stem from a number of technologies vital to both pharmaceutical and clinical laboratory procedures. Thus, although "wet" chemistry is covered (as noted) and is necessary in drug composition, analysis and testing, and, furthermore, because some biological technologies are invoked for clinical reasons, the core of descriptive and operational material is predominantly physical, optical and electronic.

This is evident in the specialty chapters dealing with the substance-based measurement technologies: chromatography (in all phases), spectroscopy and spectrophotometry, X-ray analysis, electron spectroscopy, microscopy (optical and electron) and radio isotopes.

It is intended that this hardware and operational approach will prove especially useful to medical technologists and other laboratory support personnel as well as to nurses and students who may be expected to set up and operate specific pieces of equipment. In this sense, portions of the text may serve as training aids.

For the support personnel with mechanical responsibilities—say maintenance and/or repair technicians—basic operational material is one of the primary inclusions. It is usually represented by block diagrams and equipment photographs. These are mostly accompanied by control panel layouts plus

specification sheets and/or schematic wiring diagrams unless the equipment is too complex.

For supervisory, administrative purchasing and/or diagnostic personnel some degree of useful information is afforded by comparisons, specific attributes and applications of the various equipment in drug assay and clinical operations.

The Appendices summarize data and measurement material for a number of specific technologies which supplement the basic text: osmometry, hematology, rheology, etc. Some pertinent physical data is also included on micrometrics, temperature corrections, conversion tables, and the like.

H.T.

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1: Clinical and Pharmaceutical Assay Regimens

OVERVIEW:

The general approach indicated by the title of this book is intended to reflect an understanding that both clinical procedures and the techniques of the pharmaceutical sciences are required for the study we are about to begin. The pharmaceutical clinician is a specialist developed from a combined knowledge of the technologies that comprise these areas. Such a person can also be said to be a patient-oriented technician qualified to dispense the medicine indicated by clinical diagnosis, and who, in addition, advises patients on the proper use of all medication, prescribed and patient-selected. But, primarily, the clinical laboratory technician is a technologist bent on identifying and measuring the components that comprise the substances submitted for analysis. His or her primary interest is in making quantitative determinations that will lead to definitive diagnoses, which, in most cases, means the identification of quantities that deviate from the norm. A secondary interest may be directed toward the significance of such abnormal indications (the diagnosis), and a tertiary interest may be the indicated drug therapy. Thus, the typical technician has several roles—that of the conventional clinician combined with that of a specialist in pharmakinetics, a person who uses clinical technology to determine how the prescribed drug will interact dynamically with a patient's particular physiological makeup.

Because of the wide range of instruction and data required for an understanding of clinical procedures, plus the equally complex processes involved in the preparation techniques necessary in designing, manufacturing, and packaging pharmaceutical substances, we shall concentrate our study on equipment rather than on procedures. It appears that although the well-trained clinical pharmaceutist must be familiar with all clinical and pharmaceutical areas, the separation of equipment description from procedural discussion

may be logical and useful. Equipment operation and maintenance involves the larger group of general laboratory technicians and even design and operating engineers. These groups are primarily interested in designing, operating, and maintaining the hardware rather than in detailed drug preparation and clinical procedures, which often entail pages of printed information and instruction not particularly useful to these personnel. Furthermore, many biological analyses use equipment common to that used in assaying and preparing pharmaceuticals; an example of this is the use of chromatography to analyze the components of body fluids as well as to identify antibiotics, vitamins, and other drugs independent of physiological and biological influences. So an equipment/procedures separation clearly seems appropriate.

To further refine the choice, the main technological thrust of the material in this volume is heavily electronic—it is a technical–medical volume on theory, procedures, and operation of equipment associated with clinical and pharmaceutical technology. There are also, of necessity, numerous details related to chemical, optical, and physical theory and background connected with the procedures.

The text is designed to cover three principal areas: (1) broad clinical physiology, particularly the dynamic biophysical aspects; (2) clinical pharmaceutics and the applicable drug therapy; and (3) the pure pharmaceutics of the drugs and substances indicated by diagnosis or physiological analysis. This is necessary because, as noted, clinical procedures are often closely related to drug substances and their preparation and measurement, the latter performed predominantly with electronic equipment. At this point pharmaceutics becomes equally significant in the clinical procedure, because drug preparation and therapy is one of the most important phases of patient treatment.

Our approach, then, would seem to dictate an overall study of bodily substances, followed by clinical descriptions of their measurement and analysis, with a coordination of the two through a concern with clinical pharmaceutics. On the other hand, since so many bodily substances and drugs require treatment, detection, analysis, and/or preparation, the approach could be purely that of a description of the equipment used in chemical and electronic processes. We would then cover the material in sections through discussions on the practical applications of chemistry, chromatography, spectroscopy, microscopy, and so on.

Such an approach would not, however, satisfy the technician, intern, or supervising physician, because of its lack of background and reasons for existence or application. We have, accordingly, chosen a balanced approach—one that combines study of the principles of clinical laboratory methods with those concerning the pharmaceutical sciences, with special emphasis on the equipment and physical features of both.

Analysis of Substances

Basically, then, we are concerned with the determination and quantitative measurement of (1) bodily substances, which guide the clinical approach and medical diagnosis; and (2) therapeutic substances, which are concerned with pharmaceutics. The former area is anatomically and physiologically based and indications are measured dynamically to yield continuous, *in vivo*, on-the-spot diagnosis where treatment is urgent or, in less urgent situations, where action or therapy may be delayed. The latter constitutes the world of pharmaceutics—of drugs, their generation, processing, measurement, evaluation, prescribing, and dispensing.

BODILY SUBSTANCES

The classification of *bodily substances* is based preferably on anatomical or physiological functioning. Pure analytical chemical investigation of the various substances, which might be more accurate, is not always possible, owing to the false indications that may result from the intermixture of related substances with unrelated ones.

Our approach will therefore be guided by the outline used by most clinical laboratories, modified to some degree by isolating pure equipment measurement from the nonelectronic detailed narrative procedures proposed or in practice in most clinical procedures. This separation includes, of course, optical and a number of physical means and methods (microscopy, spectrometry, spectrophotometry).

Table 1–1 lists the various bodily substances. Here we see that the body is physically constructed of solids, solutions, and gases, each of which is the concern of

Table 1.1: Body Substances

SOLUTIONS

Blood Circulatory
- Plasma
- Cell suspensions
- Electrolytes
- Lipids
- Lymph fluids

Digestive
- Saliva
- Gastric secretions
  - Stomach: pepsin, HCl, mucous
  - Small intestine: enzymes
  - Liver, Gallbladder } bile
  - Pancreas: insulin, enzymes
  - Large intestine

Excretory
- Amniotic
- Synovial
- Mucosa
- Lacrymal
- Seminal
- Mammary

Urine

Respiratory
- Nasal: mucous
- Pulmonary

Sensory
- Cerebral
- Spinal

FRAMEWORK INTEGUMENT	*GASES*	*CIRCULATORY COMPOUNDS*
Bone	Oxygen	Enzymes
Muscle	Carbon dioxide	Vitamins
Skin	Nitrogen	Chemicals
Connective Tissue		Trace minerals
Marrow		