A Color Atlas and Instruction Manual of Peripheral Blood Cell Morphology

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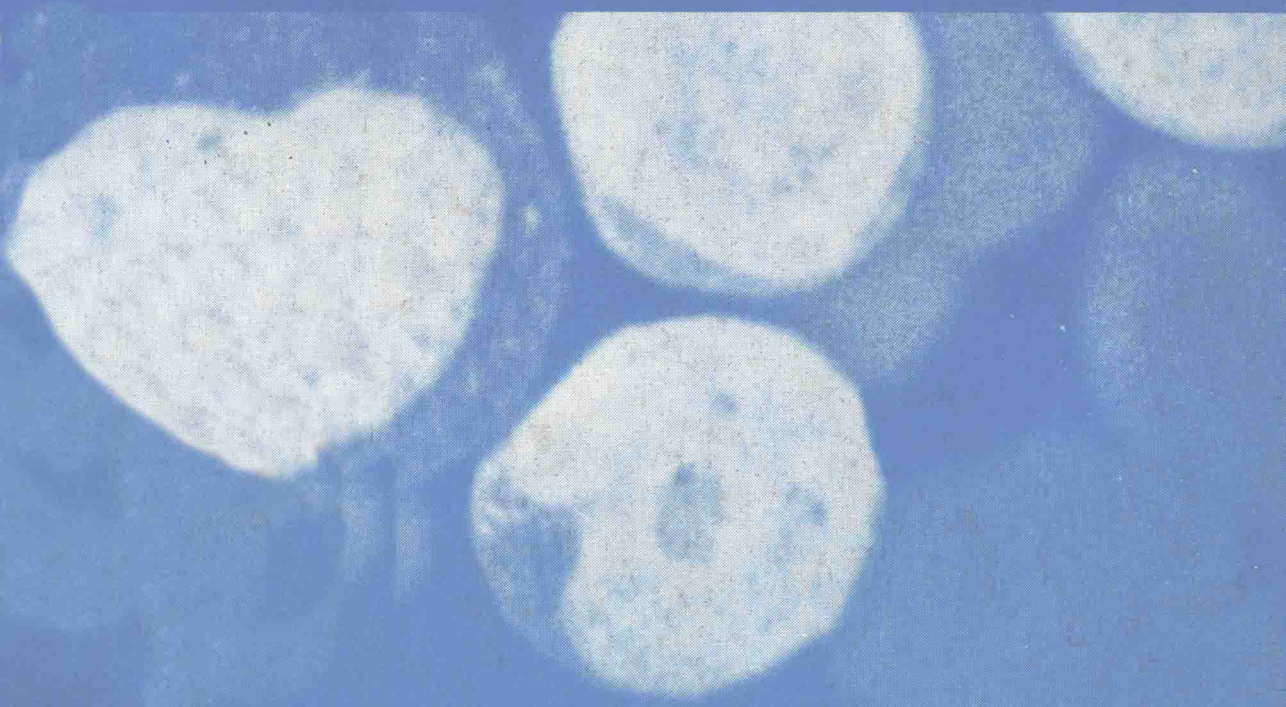

A Color Atlas and Instruction Manual of Peripheral Blood Cell Morphology

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To my husband and my father
and
To my students, past, present, and future

FOREWORD

When thought of as a tissue, blood is one of the most easily biopsied in the body. More importantly, the distribution of the various cell types in a specimen as small as 1/1,000,000 of the total blood volume is highly representative of the blood as a whole. In contrast to biopsies of other tissues, sampling error is essentially nil. The broad clinical relevance of quantitative or qualitative deviations of blood cell types from normal coupled with the aesthetic beauty of stained blood film preparations probably explains why hematology atlases have been so popular in the past and remain so today.

This atlas was written from the viewpoint of one who has dealt with the practical problems involved in teaching morphologic hematology to medical residents, students, and technologists for more than two decades. It differs significantly from those currently available. The focus for this text has been directed towards detailing the morphologic characteristics that permit one to distinguish those cell types which are especially difficult to categorize. With great skill and using innovative approaches, Ms. O'Connor has carefully dissected those features which are most helpful in arriving at the most likely identification. Recognition criteria are presented descriptively in outline form and are accompanied by quality photomicrographs along with hand drawings meticulously detailed and carefully labeled.

Red cell morphology and estimation of platelet sufficiency are also uniquely treated. The author describes in very specific terms not only what to look for but also how to objectively quantitate abnormal red cell features and platelet numbers and provides specific guidelines for distinguishing normal from abnormal.

This work is obviously a labor of love written at a time when automation of the differential white blood count suggests a lessening demand for hematology technologists. One might question the need for another atlas. However, automation could well emphasize the need for competent morphologists. In the future it is likely that normal blood samples will be screened by machine as will many commonly occurring abnormal samples. However, those that remain will be problem specimens which contemporary electronics and automated instrumentation will be unable to cope with. Technologists and pathologists will deal primarily with such interesting abnormal preparations. Ms. O'Connor's atlas will help to ease the task, especially for beginning students in hematologic morphology. It represents a welcome addition to the library of hemato-morphologists.

Leonard S. Kaplow, M.D.

PREFACE

The morphologic evaluation of cell type in Romanowsky-stained smears of peripheral blood presents continuing problems in hematology laboratories. This is quite evident in discussions, questions, survey results, and laboratory experiences. There is a desperate need for standardization in identifying cytomorphologic features and clarification of terms into one common definition for each cell type. Standardization is extremely important now when we are on the verge of having automated differential counters in our laboratories. Several authors and responsible committees have published position or clarification statements on the identification of specific cell forms. However, in the case of several ambiguous cells where there is a difference of opinion among master morphologists, the individual pathologist must choose the definition most compatible with his own experience and education, and have his laboratory staff perform blood cell identification in accordance with this definition.

Student morphologists, especially, have been greatly hampered by the lack of a good visual instruction manual that illustrates and describes each stage of maturation of every peripheral blood cell series. There is also a dearth of information about distinguishing morphologic features of cells in *dissimilar* cell lines with *similar* staining and physical characteristics, thus making identification difficult; *e.g.*, the promonocyte *versus* the myelocyte, the prorubricyte *versus* the plasma cell, etc.

It is not sufficient to tell the student or technologist, "You will learn it after a while by repetition and intuition." This leads to frustration and poor performance. It is essential to make consistent both observations and reporting for high quality results and interpretation.

I have been involved in teaching peripheral blood morphology since 1962 in two capacities. First, on a part-time basis, as the Section Chief in the hematology laboratory at Yale-New Haven Hospital, and then as the teaching supervisor in the same laboratory when student and technical staff increased to such proportions as to warrant a full-time instructor. My morphology instruction is aimed at medical technology students, freshman and sophomore medical students in the Yale School of Medicine, nursing practitioner Masters Degree candidates in the Yale School of Nursing, clinical pathology interns, and new employees to acquaint them with our differential methodology.

The instruction of this variety of individuals requires an organized study plan with a standardized nomenclature and set of definitions to establish precision on a day-to-day, person-to-person basis.

The first thing I had to do as a morphology instructor was to accumulate and maintain multiple stained smears of each blood dyscrasia. This can take months or years depending on the volume of and exposure to hematologic abnormalities at an institution. Second, a standardized procedure for the step-by-step performance of peripheral blood differentials, including nomenclature and descriptive definition of cell types, had to be written and made available to each student. Third, a set of color slides of each cell type and blood dyscrasia had to be obtained or photographed as a visual reinforcement to the written or oral instruction, especially when dealing with large groups at one time.

A major problem, however, has arisen because these teaching aids are separate and do not relate the written definition for a given cell or dyscrasia to an immediately

accessible illustration. Available literature does not present a comparative pictorial study of the stages of development accompanied by explanatory text on the morphologically distinguishing features between these stages. Furthermore, enhanced understanding by the student would result if distinctive morphologic features were to be diagrammatically labeled and placed directly below each cell pictured. This is, in my opinion, the ideal arrangement for learning cellular morphology.

In its original form, this book was a thesis prepared for Quinnipiac College, in Hamden, Connecticut, as a requirement for the degree of Master of Health Science. In its current form, it represents my attempt to provide the student morphologist with a carefully organized pictorial, diagrammatic, and written instruction manual to assist in the learning of cellular characteristics and in the making of precise, accurate identification.

While students should keep in mind that no instruction manual can provide all the requisites for sophistication in morphologic identification, I sincerely hope it serves as a catalyst to stimulate them to acquire those attributes.

Barbara H. O'Connor

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Tom McCarthy, Ann Curley, Phill Simon, and Nathan Balducci, for the photographs in Chapter 3.

INTRODUCTION

It should be noted that the manual differential peripheral blood cell count procedure in Chapter 4 has been performed by the hematology laboratory staff at Yale-New Haven Hospital for the past 15 years and has been most effective in establishing precise and accurate differential examinations. Our laboratory is staffed by approximately 50 technologists who perform 250 manual differential peripheral blood cell counts daily. Because Yale-New Haven is a large referral center for the eastern part of the United States approximately one-third of these differential counts are abnormal. Therefore, it is extremely important to have a standardized differential procedure.

Wright's-stained peripheral blood films on glass slides were used, for the most part, as source material for the photographs in this volume. The exceptions are: 1) reticulocytes were stained with new methylene blue; 2) color prints in Chapter 3 are unstained peripheral blood smears; 3) the plasmacytic series was taken from Wright's-stained pleural fluid smears; and 4) the megaloblastic rubricytic series and the megakaryocyte are from Wright's-stained bone marrow preparations.

The photographs in this volume (with the exception of those in Chapter 3) were taken from a Kohler-illuminated Nikon microscope equipped with a Nikon Automatic Microflex Model AFM photographic attachment and using Kodak Ektachrome film (ASA64). The magnification index ½ was set at ASA 100 with the D-ADJ knob set at ⅓ under, to compensate for the speed of the film used. The shutter speed was set at ⅛ second. The 100/115V transformer was set at 10. An 80B filter was placed in a holder directly under the microscope condenser lens and a didymium filter was placed directly over the light source. The microscope was equipped with 15× ocular lenses for all photographs. The 100× objective was used for all split-frame photographs, giving a total magnification of 1500×. Full-frame photographs were taken with either the 100×, 70×, 40×, or 10× objectives, giving total magnifications of 1500×, 1050×, 600×, or 150×, respectively; all magnifications are labeled throughout the text.

The photographs in Chapter 3 were taken by the x-ray photography department at Yale-New Haven Hospital with a Besler TOPCON 55 mm lens camera equipped with an 81A magenta filter and 20M filter and illuminated by a fluorescent light box. Kodak Ektachrome E-4 film was used.

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