SPUTUM

FUNDAMENTALS and CLINICAL PATHOLOGY

Compiled and Edited by

MAURICIO J. DULFANO, M.D.

Chief, Respiratory Care Section
Brooklyn Veterans Administration Hospital
Director, Inhalation Therapy
Long Island College Hospital
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Introduction by

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With Twenty-One Contributors and an Introduction by

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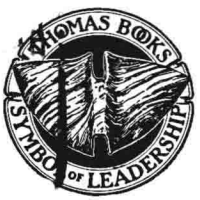

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To those who wish
to enlarge knowledge,
from those who humbly
seek enlightenment.

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PREFACE

EXAMINATION OF THE SPUTUM is an accepted procedure whose results are decisive in certain pathological conditions of the respiratory tract. Yet these conditions are limited to a narrow clinical spectrum, and *sputology* never acquired the status of a science or medical specialty. Moreover, there is a definite awareness that the potential clinical usefulness to be derived from examination of the sputum has been barely explored. It is therefore startling that for half a century, since Von Hoesslin wrote *Das Sputum* in 1921, there has been no attempt to update comprehensively the numerous advances made on this subject. This is especially extraordinary when one thinks of the number of books and treatises devoted to other biological substances, such as urine and blood, appearing in just a single year.

There are, no doubt, several reasons for this neglect, and I suspect that the cultural factor is not the least of them. Patients and doctors alike are willing to accept the need for an ever-increasing number of tests, but make a sharp distinction between tests that involve blood, urine and gastric juices from those that call for sputum or stool. The latter seem to carry with them a quality of untouchability or uncleanliness which is difficult to overcome. This is also exemplified by the definitions portrayed in dictionaries which communicate our cultural sense of revulsion toward spit and sputum. Here, one learns about the acrobatics of trajectory and reach of the accomplished spitter but little about the nature of the material itself.

The natural history of advanced bronchial inflamation has taught us that its evolution and therapeutic possibilities are more dependent on the state of the mucus content than on the behaviour of the wall musculature. In practice, however, physiology of obstructive lung disease has pursued the

study of airway (wall) dynamics while largely disregarding the significance of the *inside* mucus *dynamics*. As a result, despite increasing conceptual and methodological sophistication and tremendous expansion of efforts, the practical usefulness of this unilateral approach has been limited. The sad fact is that we still rely largely on empirical approaches for the treatment of bronchial disease, many of which do not live up to their claims. A reoriented approach to this problem must begin with dissemination of present knowledge of the basic dynamics of bronchial mucus and its relation to the bronchial milieu. This consideration led to the preparation of the first section of this book which deals with the respiratory mucosa.

The clinical pathology section reviews the most significant information obtainable from sputum examination as it may apply to diagnosis and treatment in respiratory diseases. Although many internists are familiar with the clinical usage of sputum for bacteriological and cancer diagnosis, most of the other subjects reviewed in this section have been the province of only a few research centers, and this information unfortunately, is widely dispersed in the medical and allied sciences publications.

In every chapter an effort is made to deal clearly with technical details in order to maximize the usefulness of the material to the interested reader. Emphasis is placed on established techniques; promising new avenues of approach are carefully outlined. No attempt was made to deal with any of the subjects exhaustively, and throughout the book the reader is assisted with proper references for a deeper inquiry.

Hopefully this book will fill a gap in the medical literature, both as a help to the practicing physician and as an attempt to establish the basis for a scientific approach to sputum as a biological system.

MAURICIO J. DULFANO, M.D.

INTRODUCTION

AROUND THREE THOUSAND YEARS AGO the Assyrian physicians studied sputum. They wrote that the diagnosis differs "if a patient has a constant dry cough ejecting no *saliva,* or if the lungs and the inward parts of the lungs cough up pus, or if a patient with lung disease vomits exceedingly, of if black blood comes from the mouth of the left lung."

Nearly 2,000 years ago Galenus was able to follow the progress of a pneumonia by studying the changing aspects of the sputum.

Over the course of the centuries the technique of sputum examination has made tremendous progress. Even so the characteristics of the sputum which 100 years ago led to the diagnosis of bronchiectasis still remain unchanged—a three-layered sputum in which the lower layer consists of pus, the middle layer of a greenish watery component and the upper layer of a mixture of pus and mucus from which stalactite-like formations jut out into the middle fluid layer. The importance of the presence of traces of blood in the sputum of a patient with a smoker's cough has also remained uncontested.

Antibiotics have fundamentally changed the symptomatology of the sputum-producing diseases—no more lung abscesses after tonsillectomy, very few lung abscesses in the atelectasis which results from the closure of a bronchus by a malignant tumor.

Dr. Dulfano has rendered a great service to his colleagues by collecting authoritative chapters on the most modern technique of sputum examination.

The anatomy and physiology of the mucociliary organ which extends from the nasal cavity to the alveoli, the malignant and nonmalignant cytology of the sputum have been

described by experts. The illustrations are magnificent. The precautions that must be taken in order to obtain satisfactory sputum specimens for cytologic examination are emphasized in detail. Much too often a physician gives a patient only a receptacle and orders him to deposit all his sputum in the course of twenty-four hours. This procedure was sufficient for the culture of tubercle bacilli from the sputum; the acid fast bacillus can survive even after it has been standing around for one or more days. In tuberculosis it is of no importance whether the *sputum* also contains food and other extraneous particles. The carcinoma cells, however, rapidly change and should be fixed immediately after expectoration. Even the washings obtained during bronchoscopy of carcinoma patients are often negative because they have been standing around too long before reaching the pathologic laboratory.

The chapter on electrophoretic investigation of the proteins of the sputum has been written by Masson and Heremans, (the latter one of the founding fathers of electrophoresis of proteins in general) . The articles on the pharmacology of the sputum-producing diseases and of the special diagnostic techniques used for the study of sputum also provide greatly needed information.

Thus, the specialists in lung diseases will find it very frequently necessary to consult Dr. Dulfano's book.

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CONTENTS

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CHAPTER I

THE MUCUS SYSTEM

MAURICIO J. DULFANO

MUCUS IS A UBIQUITOUS substance found in man and most animals and represents one of the fundamental classes of polymers in the makeup of the animal body. Mucous substances are found in salivary, gastrointestinal, respiratory and urogenital secretions. They are also constituents of cornea, bone and connective tissues. Although much has been learned about the component fractions of mucus, our knowledge of the total material as a biological product and its function in its natural environment is still obscure. An understanding of the function of mucus requires an interdisciplinary approach to structure, physicochemical properties, mode of secretion and excretion and interaction with surrounding structures (1). None of these variables are well understood at the present time, and we are also hampered by the relative inaccessibility of native mucus. This is a particular problem in the respiratory apparatus where the material spontaneously obtained by cough carries strange additives and is quite different in structure and properties from the original secretion. Any expectorate represents a pathological condition, at least in terms of oversecretion and therefore indicative of altered structure and function.