1 Glimpses into the Realm of Freeze-Drying: Classical Issues and New Ventures

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INTRODUCTION

In their 1906 paper to the Académie des Sciences in Paris, Bordas and d'Arsonval demonstrated for the first time that it was possible to dry a delicate product from the frozen state under moderate vacuum. In that state it would be stable at room temperature for a long time and the authors described, in a set of successive notes, that this technique could be applied to the preservation of sera and vaccines. Freeze-drying was then officially borne, despite its having been in use centuries ago by the Inca who dried their frozen meat in the radiant heat of the sun in the rarified atmosphere of the Altiplano.

However, we had to wait until 1935 to witness a major development in the field when Earl W. Flosdorf and his coworkers published some very important research on what they called, at the time, lyophilization (this name was derived from the term *lyophile* coming from the Greek λ υ ο ς and φ ι λ ε ι υ, which means "likes the solvent," describing the great ability of the dry product to rehydrate again). Freeze-drying had then received a new name, which has been in current use since then, together with cryodesiccation.

Many authors, in different comprehensive books dedicated to freeze-drying, have already described in full detail the scientific history of this method, and we will not attempt to do it again. Moreover, in these last 75 years, much research and substantial development have been devoted to freeze-drying, and it would be of little use to list papers that are well known and available to all the specialists concerned.

This, indeed, is the very reason why the present book has been designed to present to the readers essentially new experimental methods and data, as well as recent developments on our own basic understanding of the physical and chemical mechanisms involved in cryodesiccation.

Nevertheless, it would not be fair to skip the names of some of the great pioneers in the field. Earl Flosdorf, Ronald Greaves, and François Henaff fought the difficult battle of the mass production of freeze-dried human plasma, which was used extensively during World War II. To that end, they engineered the appropriate large-scale equipment. Sir Ernst Boris Chain, the Nobel Laureate for penicillin, introduced freeze-drying for the preparation of antibiotics and sensitive biochemicals. Isidore Gersh and, later on, Tokio Nei and Fritjof Sjostrand produced remarkable photographs of biological structures prepared by freeze-drying for electron microscopy. Charles Mérieux, on his side, opened wide new areas for the industrial production of sera and vaccines. In parallel, he developed a bone bank, a first move in a field where the U.S. Navy Medical Corps invested heavily a few years later under Captain Georges Hyatt.

At the same time, cryobiology was getting its credentials with many devoted and gifted scientists such as Basil Luyet, Alan Parkes, Audrey Smith,

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