

In addition, some fish, or some parts of fish, can supply substantial amounts of vitamin A, iron, fluorine, and iodine—nutrients important in the prevention of abnormalities which at present affect considerable numbers of people throughout the world.

But, fish must be harvested and suitably preserved so as to ensure its availability to those who need it. It is well to know that while new methods such as radiation-sterilization may become important in the future, at present, there is no need for other than methods which are well established such as freezing and canning. Application of them "could satisfy all reasonable needs for years to come".

There are some potential dangers in eating fish. This food may carry a number of organisms pathogenic to man, including salmonellae and *Clostridium botulinum*; there is the curious condition known as Haff disease in which there is excruciating pain in the muscles, probably caused by ingesting fish contaminated with algae; some people develop allergic reactions after eating some kinds of fish; some fish naturally contain materials poisonous to man. Also, those engaged in the fish industry are exposed to a number of hazards to their health.

These and other important topics are discussed in detail in the second volume of *Fish as Food*. The sea, from which so much of our fish is obtained, has no physical national barriers, and it is appropriate that those who have contributed to this book belong to half a dozen different countries. Under the sub-title *Nutrition, Sanitation, Utilization*, Georg Borgstrom has assembled impressive reviews from several authorities. The editor himself has written a considerable amount of the volume.

The book is interesting throughout, and many parts are fascinating. It would be inadequate, however, to leave its assessment there, because it is also an important book and should be studied by everyone having anything to do with human nutrition.

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WOOD EXTRACTIVES

Wood Extractives and Their Significance to the Pulp and Paper Industries

Edited by W. E. Hillis. Pp. xvii + 513. (New York and London: Academic Press Inc., 1962.) 114s. 6d.

AS Prof. Erdtman remarks in his foreword to this book, the days are long past when wood was regarded as merely "cellulose and lignin", and it is now generally recognized, not only that woods contain a very great variety of extraneous components, but also that these components are responsible for many of the characteristic features of different timbers. The study of the extractives of wood has developed into an important branch of wood chemistry, particularly within the past 10-15 years, and the time is ripe for a survey of the present state of knowledge. This has now been undertaken by Dr. W. E. Hillis of the Division of Forest Products, Commonwealth Scientific and Industrial Research Organization (Australia), with the aid of a number of collaborators, all of whom are well known for their work in this field.

The book opens with an excellent account of the main structural features of wood and of the processes by which a tree grows. This is essential to an understanding of the part played by the minor components and their location in the tree. Particular attention is directed to the process of heartwood formation which is relevant to the question, discussed in a later chapter, of the origin of heartwood extractives. A short account, which might with advantage have been expanded, is given of the influence of extractives on wood properties and utilization.

After this introduction the remainder of the book is divided into four sections, of which three are concerned with the extractives themselves while in the final section

some of the ways in which these components influence the utilization of wood for manufacture of pulp and paper are considered. In the treatment of the extractives the main emphasis is placed on the polyphenolic constituents of wood, which form the subject of seven of the nine chapters in this portion of the book. The polyphenols range in complexity from the simple C_6 and C_{15} compounds (flavonoids and hydroxycinnamic acids) to the highly complex tannins and are of such widespread distribution that it is right that they should occupy a prominent place in any discussion of wood extractives.

Dr. Hillis has performed a valuable service in bringing together the points of view of the organic chemist, the biochemist and the botanist concerning this group of compounds. In his own contribution on the distribution and formation of polyphenols within the tree he discusses the various theories that have been advanced to account for the origin of heartwood polyphenols, and gives reasons for his own view that they are formed *in situ* from carbohydrates. E. C. Bates-Smith's chapter on the simple polyphenolic constituents of plants includes an account of his very interesting studies of the systematic distribution of these compounds—particularly the leucoanthocyanins and trihydroxyphenolic compounds—in the leaves of plants. The analogous work of Erdtman on the heartwood components of conifers, which is more directly relevant to the present book, receives only very brief mention. Other chapters in this section of the book include well-presented accounts of the chemistry of the lignans and the condensed tannins by D. E. Hathway and of the hydrolysable tannins by L. Jurd. Two chapters are devoted to the biosynthesis of polyphenols and reflect the present-day interest in biosynthetic processes in plants, the study of which has been so greatly assisted by the use of radioisotope tracer techniques.

The succeeding section of the book is entitled "Other Extractives in Wood" and consists of two chapters dealing with tropolones and wood resins respectively. J. A. F. Gardner gives a useful survey of the properties and distribution of the relatively small number of tropolones that have been found in wood, while D. B. Mutton describes the resins occurring in softwoods and hardwoods. The discussion of wood resins is confined mainly to North American timbers and no mention is made of the resinous tropical species, for example, the dipterocarps.

Finally, an account is given of a variety of problems arising in the technical processes of pulp and paper manufacture which are related to the presence of extractives in the wood. These include such diverse phenomena as the inhibition of the pulping reaction by pinosylvins, corrosion of digesters, discoloration of pulp, deposition of scale in digesters and piping, colour changes during storage of newsprint, and pitch problems in pulping. The ways in which these problems are tackled provide a good illustration of the practical value of a knowledge of the chemistry of the extractives concerned.

This book is the first major work on wood extractives that has been compiled and is an important addition to the literature of wood chemistry. Much of its value lies in the varied outlooks of the several authors, who approach their subjects from chemical, botanical, biochemical and industrial angles and yet contrive to blend their contributions into a unified whole. Its greatest weakness lies in its bias in favour of polyphenolic compounds, so that other important classes of extractives, including the terpenes (other than the resin acids) and their glycosides, carbohydrates, and nitrogenous compounds, including alkaloids, are neglected or inadequately dealt with. The production is excellent and the book is particularly well provided with literature references and indexes. It is primarily a book for research workers in this field and will give them much food for thought, but it may also be read with profit by a much wider circle.

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