

# VEGETABLE GUMS *and* RESINS

*by*

F. N. HOWES, D. Sc.

*Principal Scientific Officer, Royal Botanic Gardens, Kew,  
Formerly Botanist, Agricultural Department, Union of South Africa,  
and Economic Botanist, Agricultural Department, Gold Coast.*



1949

WALTHAM, MASS., U.S.A.

Published by the Chronica Botanica Company

**First published MCMXLIX  
By the Chronica Botanica Company  
of Waltham, Mass., U. S. A.**

COPYRIGHT, 1949, BY THE CHRONICA BOTANICA CO.  
All rights reserved, including the right to reproduce  
this book or parts thereof in any form

*Authorized Agents:—*

- New York, N. Y.:** STECHERT-HAFNER, INC.,  
31 East 10th Street.
- San Francisco, Cal.:** J. W. STACEY, INC.,  
551 Market Street.
- Ottawa, Ont.:** THORBURN AND ABBOTT, LTD.,  
115, Sparks Street
- México, D. F.:** AXEL MORIEL SUCRS.,  
San Juan de Letran 24-116; Ap. 2762.
- Lima:** LIBRERIA INTERNACIONEL DEL PERU,  
Casa Matriz. Boza 879; Casilla 1417.
- Santiago de Chile:** LIBRERIA ZAMORANO Y CAPERAN,  
Compañía 1015 y 1019; Casilla 362.
- Rio de Janeiro:** LIVRARIA KOSMOS,  
Rua do Rosario, 135-137; Caixa Postal 3481.
- São Paulo:** LIVRARIA CIVILIZAÇÃO BRASILEIRA,  
Rua 15 de Novembro, 144.
- Buenos Aires:** ACME AGENCY, SOC. DE RESP. LTDA.,  
Suipacha 58; Casilla de Correo 1136.
- London, W. C. 2:** WM. DAWSON AND SONS, LTD.,  
*Chief Agents for the British Empire,*  
Cannon House, Macklin Street.
- London, W. C. 1:** H. K. LEWIS AND CO., LTD.,  
136, Gower Street.
- Uppsala:** A.-B. LUNDEQUISTSKA BOKHANDELN.
- Groningen:** N. V. ERVEN P. NOORDHOFF,  
*Chief Agents for Continental Europe.*
- Paris, VI:** LIBRAIRIE H. LE SOUDIER,\*  
174, Bvd. St. Germain.
- Torino:** ROSENBERG & SELLIER,  
Via Andrea Doria 14.
- Madrid:** LIBRERIA J. VILLEGAS,  
Preciados, 46.
- Lisbon:** LIVRARIA SÁ DA COSTA,  
100-102, R. Garrett.
- Moscow:** MEZHDUNARODNAJA KNIGA,  
Kuznetski Most 18.
- Peiping:** FRENCH BOOKSTORE,  
Grand Hôtel de Pékin.
- Tokyo:** MARUZEN COMPANY, LTD.,  
6, Tori-Nichome Nihonbashi; P. O. Box 605.
- Calcutta, Bombay, and Madras:** MACMILLAN AND CO., LTD.
- Cape Town:** OXFORD UNIVERSITY PRESS  
Markham's Buildings
- Sydney:** ANGUS AND ROBERTSON, LTD.,  
89 Castlereagh Street, Box 1516D.D. G.P.O.
- Melbourne, C. 1:** N. H. SEWARD, PTY., LTD.,  
457, Bourke Street.

*Made and printed in the U. S. A.  
Designed by Frans Verdoorn*

## *Preface*

The vegetable gums and resins constitute an important group of economic plant products and are utilised in many ways. Their uses by man, in fact, go back to the earliest times. In modern industry large quantities of both resins and gums have been used for many years in manufacturing processes of various kinds. Their uses continue to increase. The world trade in natural resins has been estimated to be in excess of three quarters of a million tons per annum. The value of the yearly import of gum arabic into Great Britain alone in normal times has commonly been in excess of a quarter of a million pounds sterling. This does not include the various other gums that are in regular use.

The terms "gum" and "resin" are often used in a somewhat indefinite or vague manner. They have been applied to almost any form of plant exudation, even to those that are of a predominantly rubbery nature. The wild or jungle rubber industry that thrived in the past in many parts of the world and was revived during the Second World War, was often referred to as the "gum industry" and those engaged in it as "gum collectors." "Chicle gum" and "balata gum" are expressions frequently heard at the present time. In addition to its use in connection with rubbery exudations of this kind, the word "gum" is also applied to some of the true resins, as in "gum copal," "gum accroides," "kauri gum" and "varnish gums," where the resins employed in varnish making are intended. Fortunately, this misuse of the term "gum" appears to be on the decline.

In this work the words "gum" and "resin" are used only in the more correct or technical sense. No attempt has been made to deal with the large group of substances of a rubbery nature sometimes called "gums." A simple, if incomplete, distinction between gums and resins is that the true gums are more or less soluble in water or swell to a jelly-like mass but remain insoluble in organic solvents, whereas the resins are unaffected by water, but are more or less soluble in various organic solvents. Some plant exudations consist, in the natural state, of a mixture of both gum and resin and are styled gum-resins. The term oleo-resin is used for those resins—of a more or less soft consistency—that occur mixed with a relatively large amount of essential oil. Some resinous plant exudations, particularly those that are medicinal, consist of mixtures of resin, gum and oil, and may be termed oleo-gum-resins.

The number of species that yield gums or resins in greater or less amount throughout the Vegetable Kingdom must be many thousands. For this reason a selective treatment has been necessary in this work. Special emphasis is placed on those gums and resins that are of commercial importance, or which for some reason or other are of special interest. Partic-

ular attention has been given to those that have only become of commercial importance in comparatively recent years, and which are not dealt with in older works of reference. Examples of these are carob seed or locust gum, karaya or *Sterculia* gum and other tragacanth substitutes, also certain *Acacias* now known to be exploited for gum, particularly in East Africa.

Owing to the fact that the true gums as a group have entirely different properties and uses from the resins and interest different classes of users, it has been considered desirable to treat the two groups separately. The book has, therefore, been divided into two parts.

Among peoples all over the world, including the aborigines of Australia and primitive African and Asiatic tribes, certain gums have been used for food as far back as history relates. The adhesive properties of gums have also been utilized from early times, particularly in preparing paints and pigments. Gum arabic in North Africa has been an article of commerce from at least the first century of the Christian era and the trade existed throughout the Middle Ages. The Sudan gum arabic trade with European and other countries developed steadily during the last century, in spite of temporary set-backs through political disturbance, and reached still greater proportions in the present century, thanks largely to improved transport facilities (railways) in the producing areas.

The uses of resins by man are of equal antiquity to those of gums. Many have good combustible properties and have been used for torches and for lighting from time immemorial, particularly by the Malays and other Asiatic and Pacific races. Primitive peoples also commonly make use of resinous materials for caulking their boats. Several of the resins or oleo-resins of the Mediterranean region and near East have long been esteemed for their medicinal properties or their fragrance and hence their age long use for religious purposes (incense). Varnishing or varnish making has always been one of the important uses for vegetable resins and this goes back to early times in some countries. The Ancient Egyptians employed resin (probably a crude oleo-resin) for coating or varnishing mummy cases. There is also evidence that the Incas of South America used embalming resins. It is known that oleo-resins were distilled in Europe in the Middle Ages. The early painters had many formulae and recipes in which the resins and oleo-resins then available, such as mastic, sandarac and pine resin, were ingredients.

With regard to modern uses of vegetable resins the paint, varnish, linoleum, paper sizing and soap making trades use considerable quantities. The relative amounts of the different kinds of resins used for industrial purposes in the past have varied considerably as perusal of the following pages will show. At one time it was thought synthetic resins would completely replace natural resins for many purposes, particularly in the paint and varnish industries, but this has not materialised and the natural resins continue to hold their own and to be imported into manufacturing countries in large quantities. What the future will hold no one can foretell, but in the light of recent developments there are strong indications that the use of natural resins will increase rather than diminish. Recently research has developed new types of resin which are combinations of synthetic and of natural resins, the best examples being the so-called "copal type synthetics."

These resins are proving very promising. They combine desirable features of both the synthetic and the natural or fossil resins.

There have been many important contributions to the literature of vegetable gums and resins, alike from the chemical and physical, and the botanical aspects. A few comprehensive works have appeared in book form and many notable contributions are to be found scattered over a wide range of literature and in periodical publications of all kinds.

With regard to gums, an account of the gums of India was given by Dr. M. C. COOKE, in 1874, from the information then available. This was augmented to some extent a few years later by DYMCK WARDEN and HOOPER in their memorable *Pharmacographia Indica*, and by WATT in his well known *Dictionary of the Economic Products of India*. At about the same time, J. H. MAIDEN and his co-workers were making a study of the exudations of Australian plants and published many detailed accounts of the gums and resins of that Continent. In 1909 the Imperial Institute published a special report on "Gums and Resins" which included much useful general information and also accounts of investigations carried out at the Imperial Institute on gums and resins from various parts of the world. Since that time numerous articles on gums have appeared in the *Bulletin of the Imperial Institute*. In 1911, H. J. DE CORDEMOY's "Les Plantes à Gommés et à Résines" appeared, and in 1920 a small book by E. J. PARRY intended for the general reader was published. Five years later a comprehensive monograph on gum arabic by H. S. BLUNT, who had spent many years in the gum producing districts of the Sudan, made its appearance. The East African *Acacia* gum industry was dealt with in some detail by D. W. MALCOLM in 1936.

During the last two decades notable contributions to the chemistry of some of the better known vegetable gums have been made, both in Europe and the United States. Special attention has been given to those gums (mannogalactans) used as stabilizing and thickening agents in various food products. Much of this work has been summarized by A. G. NORMAN (1937), who points out how much awaits investigation in this particular field. Another admirable account of recent work on gums has been given by C. L. MANTELL (1947). What is known of the chemistry of all the more important gums (and vegetable mucilages) used in industry is dealt with by this writer.

Turning to resins, much of the existing knowledge, particularly in relation to their chemistry, is due to the investigations of Prof. A. TSCHIRCH of Berne, the gifted chemist, botanist and pharmacognosist. His work was carried on by collaborators after his death. TSCHIRCH's well known and comprehensive work "Die Harze und die Harzbehälter" first appeared in 1900, with a considerably enlarged edition, in two volumes, in 1906. A third revised edition appeared in 1933-36. Other notable contributions to the literature of natural resins have been "Die Natürlichen Harze" by H. WOLFF in 1928 and "Natural Varnish Resins" by T. HEDLEY BARRY in 1932, both these writers being well known authorities on resins. The commercial manufacture of varnishes is a complex and highly technical subject with a literature of its own, recent or well known contributions being those of W. KRUMBHAAR (1947), H. W. CHATFIELD (1944), MANTELL (1942),

R. S. MORREL (1923), and J. GAULD BEARN (1923). In recent years some of the commercial resins have received more attention than others, both from the laboratory worker and the worker in the field. The literature on colophony or pine resin is now very extensive. Belgian workers have added much to the knowledge of Congo copal. "Manila" or East Indian copal and its exploitation has been closely studied by C. VAN DE KOPPEL, while T. A. BUCKLEY has given a detailed account of the various Malayan dammars. Lac in India has been the subject of much promising work, thanks to the Indian Lac Research Institute, and to workers in Great Britain and the United States.

A word of explanation may be desirable in connection with the use of botanical names in this book. As the average reader is not likely to be interested in the authority for the name but only in the plant itself or its product, the authorities have been omitted purposely from the text. They are, however, available for those who may require them in the index of botanical names at the end of the book.

The writer is indebted to the Director of the Royal Botanic Gardens, Kew, and to the Director of the Imperial Institute, South Kensington, for the use of specimens and for other facilities afforded by these two Institutions, also to colleagues and to various firms connected with the gum and resin trade for information and assistance willingly given.

THE AUTHOR.

# *Contents*

Preface .....	vii
Contents .....	xiii

## PART I: Gums

### *Chapter I*

The Nature and Uses of Gums .....	3
The Occurrence and Origin of Gum in Plants .....	3
The Different Kinds of Gum .....	5
a. Soluble gums .....	5
b. Insoluble gums .....	5
Physical Properties .....	6
Colour and form .....	6
Taste and smell .....	7
Hardness and density .....	7
Polarization .....	7
Solubility .....	7
Viscosity and tenacity .....	8
Colloidal nature .....	8
Chemical Properties .....	8
Gum arabic .....	9
Gum tragacanth .....	10
Other commercial gums .....	11
The Commercial Valuation of Gums .....	11
Industrial and Other Uses .....	12

### *Chapter II*

Gum Arabic and Other Acacia Gums .....	16
THE SUDAN .....	16
The History and Present Importance of the Gum Trade....	16
Distribution and Descriptions of Gum Yielding Species ....	17
Collection and Tapping .....	21
Marketing, Bleaching and Grading .....	22
Cultivation .....	24
FRENCH WEST AFRICA .....	24
Past and Present Extent of the Senegal Gum Trade .....	24
Main Gum Yielding Regions .....	25
Classes of Gum .....	25
Gomme du bas du fleuve .....	25
Gomme du haut du fleuve .....	25
Gomme friable, Salabreda, or Sadra beida .....	26

NIGERIA .....	26
Limited Extent of Export Trade .....	26
Gum Producing Areas .....	27
Collection .....	27
Tapping Experiments .....	27
Kinds of Gum .....	28
EAST AFRICA .....	29
The Tanganyika Export Trade .....	29
Species Yielding Gum .....	29
Collection and Marketing .....	30
OTHER COUNTRIES PRODUCING ACACIA GUMS .....	33
North Africa—Excluding the Nile Region .....	33
Southern Africa .....	34
India .....	35
Australia .....	37

### Chapter III

<b>Gum Tragacanth and Similar Gums .....</b>	<b>39</b>
Gum Tragacanth .....	39
Botanical and geographical sources .....	39
Collection .....	40
Grading and marketing .....	41
Karaya Gum .....	41
Carob Seed Gum .....	44
Kutira Gum .....	47
Other Gums of the Tragacanth Type .....	49

### Chapter IV

<b>Some Well Known or Much Used Asiatic Gums .....</b>	<b>52</b>
Aegle marmelos .....	55
Albizzia lebbek .....	55
Albizzia odoratissima .....	55
Albizzia procera .....	55
Albizzia stipulata .....	56
Aleurites moluccana .....	56
Anogeissus latifolia .....	56
Bauhinia spp. ....	56
Buchanania lanzan .....	57
Cedrela toona .....	57
Chloroxylon swietenia .....	57
Delonix regia .....	57
Elaeodendron roxburghii .....	57
Feronia acidissima .....	57
Lannea grandis .....	58

Mangifera indica .....	58
Melia indica .....	58
Prosopis spicigera .....	58
Sesbania grandiflora .....	59
Spondias spp. ....	59
Terminalia spp. ....	59

### Chapter V

<b>Gums of the New World</b> .....	60
South America .....	60
Central America .....	63
North America .....	65

### Chapter VI

<b>Miscellaneous and Little Known Gums</b> .....	67
Adansonia .....	67
Adenanthera .....	67
Afzelia .....	67
Albizzia .....	67
Anogeissus .....	67
Atalaya .....	69
Balsamocitrus .....	69
Bauhinia .....	69
Berlinia .....	69
Bombax .....	70
Borassus .....	70
Bosistoa .....	70
Brachystegia .....	70
Burkea .....	70
Capparis .....	70
Careya .....	70
Cassia .....	70
Cedrela .....	71
Ceiba .....	71
Ceratopetalum .....	71
Chickrassia .....	71
Citrus .....	72
Cocos .....	72
Cola .....	72
Combretum .....	72

Cordia .....	72
Cordyla .....	73
Corypha .....	73
Crataeva .....	73
Cussonia .....	73
Cycas .....	73
Dichrostachys .....	74
Echinocarpus .....	74
Elaeocarpus .....	74
Encephalartos .....	74
Entada .....	75
Erythrophloeum .....	75
Flindersia .....	75
Garuga .....	75
Geijera .....	75
Geodorum .....	75
Hakea .....	75
Khaya .....	75
Lagerstroemia .....	76
Lannea .....	76
Macrozamia .....	76
Melia .....	76
Melicope .....	76
Moringa .....	77
Owenia .....	77
Panax (Tieghemopanax) .....	77
Penaea .....	77
Pentaceras .....	77
Prunus .....	78
Pseudocedrela .....	78
Saccopetalum .....	78
Sarcostemma .....	79
Schefflera .....	79
Sclerocarya .....	79
Semecarpus .....	79
Sloanea .....	79
Soymida .....	79
Tamarindus .....	79
Tarrietia .....	79
Terminalia .....	79
Thevetia .....	81
Virgilia .....	81

## PART II: Resins

### *Chapter VII*

<b>Properties and Uses of Resins</b> .....	85
The Origin of Resin in the Plant .....	85
The Main Resin Producing Families .....	86
The Physical Properties of Resins .....	87
Chemical Composition .....	88
Main Uses: Competition from Synthetic Resins .....	89

### *Chapter VIII*

<b>The Copals</b> .....	93
Congo Copal .....	93
West African Copals .....	95
East African Copal .....	96
South American Copals .....	98
East Indian and Manila Copal .....	99

### *Chapter IX*

<b>Rosin or Colophony</b> .....	104
The Industry in the United States .....	104
The Industry in France .....	106
Rosin Production in Other European Countries .....	108
Spain and Portugal .....	108
Greece .....	109
Russia .....	109
Germany .....	109
Austria .....	110
Production in India and the East .....	110
India .....	110
Dutch East Indies .....	111
Philippines .....	113
Production in Central American Countries .....	113

### *Chapter X*

<b>Dammars</b> .....	115
East Indies .....	115
Malaya .....	117
Damar pēnak .....	117
Other Malayan dammars .....	119
Siam .....	120
India, Burma and Ceylon .....	121

*Chapter XI*

<b>Kauri Resin</b> .....	123
The History of the Industry in New Zealand .....	123
The Kauri Pine and its Distribution .....	123
Collection of the Resin .....	124
Grading and Marketing .....	125
Main Uses .....	126

*Chapter XII*

<b>Lac Resin and Shellac</b> .....	127
The Lac Insect .....	127
Host Plants and Cultivation .....	128
Collection and Preparation of Lac .....	129
Production and Uses .....	131
Lac Producing Areas .....	132
India .....	132
Burma .....	133
Siam .....	133
French Indo-China .....	133

*Chapter XIII*

<b>Some Little Used Varnish Resins</b> .....	135
Acaroid Resin or "Gum Accroides" .....	135
Sandarac .....	136
African sandarac .....	136
Australian sandarac .....	137
Mastic .....	138
Dragon's Blood .....	139

*Chapter XIV*

<b>Elemi</b> .....	141
Manila Elemi .....	141
Other Elemis .....	143
Yucatan elemi .....	143
Mexico .....	143
Brazil .....	143
West Indies .....	143
Africa .....	143
Mauritius .....	144
East Indies .....	144

*Chapter XV*

<b>Natural Lacquers</b> .....	145
Chinese and Japanese Lacquer .....	145

Burmese Lacquer .....	146
Other Natural Varnishes .....	148

### *Chapter XVI*

<b>Frankincense and Myrrh</b> .....	149
Frankincense .....	149
Myrrh .....	153

### *Chapter XVII*

<b>Medicinal and Other Resins</b> .....	154
Abies .....	154
Ailanthus .....	154
Aloe .....	154
Anacardium .....	155
Anisoptera .....	156
Araucaria .....	156
Artocarpus .....	157
Bursera .....	157
Cistus .....	158
Convolvulus .....	158
Copaifera .....	158
Dipterocarpus .....	158
Dorema .....	159
Elaeagia .....	160
Euphorbia .....	160
Ferula .....	160
Garcinia .....	161
Gardenia .....	162
Guaiacum .....	162
Ipomoea .....	162
Laretia .....	162
Larix .....	162
Liquidambar .....	162
Myroxylon .....	163
Picea .....	165
Pinus .....	165
Piper .....	165
Podophyllum .....	165
Schinus .....	165
Sindora .....	166

Spermolepis .....	166
Styrax .....	166
Thapsia .....	167
<b>Bibliography</b> .....	169
<b>Index of Botanical Names (with authorities)</b> .....	177
<b>Index of Common Names and Authors</b> .....	183



## Part I

# GUMS



## Chapter I

### THE NATURE AND USES OF GUMS

**The Occurrence and Origin of Gum in Plants:**—The vegetable gums are a group of plant products resembling carbohydrates and widely distributed in the Vegetable Kingdom. They are characterized by the ability to dissolve in water forming viscid solutions, or by absorbing water to form jellies or gelatinous pastes as in tragacanth and allied gums. On desiccation or exposure to the air these solutions or pastes lose their water and dry to hard, clear, rather glassy masses.

Gums are to be found in a greater or less degree in most plant families. Various organs of the plant may produce or secrete them. They may be produced only in very small quantity and not be readily discernible, or they may be produced very copiously forming large, conspicuous incrustations on the surface, as with most of the commercial gums, particularly the tree gums. Certain families of flowering plants are notable for the number of species they contain that are free gum yielders. Notable among them is the *Leguminosae*, in which a hundred or more species of *Acacia* alone are known to yield gum, including those that are commercially important for gum arabic. Several species of *Astragalus* are also free gum yielders and are the source of gum tragacanth. The following are additional notable gum yielding genera in the family—*Albizzia*, *Bauhinia*, *Caesalpinia*, *Ceratonia*, and *Pithecolobium*. Other important gum yielding families are—*Anacardiaceae*, *Combretaceae*, *Meliaceae*, *Rosaceae* and *Rutaceae*.

Various views have been put forward concerning the processes whereby gum is formed in plants. In some instances it is believed that gum is part and parcel of the normal metabolism of the plant and is in every sense a natural or physiological rather than a pathological product. While some vegetable gums may originate in this manner and be part of the normal cell content, as in the case of the gums in sugar beet and yeasts, it is now generally agreed that most gums owe their origin to infection of the tissues by some form of micro-organism (A. C. THAYSEN and H. J. BUNKER, 1927). In some cases the production of gum has been attributed to fungi attacking the plant, these fungi being responsible for enzymes that penetrate the tissues and transform the celluloses and hemicelluloses of the cell wall into gum. This may be the origin of the gum produced in the "gummosis" diseases of certain deciduous and other fruit trees. In other cases, particularly with species of *Acacia*, gum formation has been attributed to bacterial action and it has even been claimed that specific bacteria are capable of producing different kinds of gum, but as yet there is little concrete evidence in support of this. It has even been suggested that a system of inoculating trees to induce a regular and uniform production of gum