

Toxic Woods

BRIAN WOODS* AND C.D.CALNAN†

SUMMARY

Eighty-three cases of dermatitis caused by wood or sawdust have been seen at St John's Hospital for Diseases of the Skin, London, in the last 20 years. The clinical details and results of patch tests are reported. The literature on dermatitis, mucosal irritation, asthma and other toxic effects of woods of some 300 botanical species is reviewed at length, with an index of scientific, trade and vernacular names, chemical formulae of the known sensitizing substances, and a table of the 28 toxic woods most often encountered. Pathogenesis, diagnosis and prophylaxis are discussed.

KEY WORDS

Contact dermatitis
Industrial dermatitis
Urticaria
Asthma
Hay fever

Wood
Liverworts
Lichens

INTRODUCTION

The baleful effects of some trees have always been a favourite subject for mythology, and in early would-be scientific texts like Pliny's *Natural History* the borderline between fact and fiction was sometimes hazy. His striking account of travellers in Gaul poisoned by wine from a flask of yew wood did not convince Evelyn (1664), who was more inclined to blame the wine than the wood. 'How are poor Trees traduc'd'. Gerard (1597) quoted his own experience to refute the persistent notion that the very shade of the yew tree was harmful.

One might be equally sceptical about the belated story (Richard, 1843) of the French soldiers in Napoleonic times who were taken ill after eating meat cooked on spits of oleander wood, if there were not modern reports of similar incidents in America (Hausen, 1970). As early as the seventh century dermatitis due to Japanese lacquer was known in the Orient, and it spread to Europe with the eighteenth-century vogue for chinoiserie (Bateman, 1819). The properties of other tropical trees with caustic sap, such as the manchineel and rengas, were wildly exaggerated in travellers' tales reaching Europe, culminating in the curious myth of the deadly Upas tree (Woods, 1962).

The occupational risks from sawdust with which this paper is mainly concerned were first clearly described by Ramazzini (1700), who referred to irritation of the nose and eyes, most marked in pit-sawyers. He named no woods as particularly troublesome except cypress, the smell of which gave some turners a headache. For two centuries little or nothing was added to this by medical writers. In 1902 Oliver published *Dangerous Trades* which included an account of coryzal symptoms in men

* Consultant Dermatologist, Barnet General Hospital, and † Institute of Dermatology, London.

working with sequoia wood, and in the same year Young described reactions to a boxwood substitute (see para. 156). In the next few years teak, rosewood and satinwood dermatitis were reported, but most publicity went to 'African boxwood' (183), which caused such alarming symptoms in Lancashire shuttlemakers that men refused to work with it and a full clinical and biochemical investigation had to be undertaken (Legge, 1905, 1907).

Poisoning by colonial timbers may have been regarded with some *schadenfreude* at first in Germany as a subject in which England had a right to lead the field, but similar reports soon came from German authors. A review by Czimatis & Hagemann (1910) was widely read, and their list of toxic woods copied by other writers together with their botanical names. Unfortunately these were not always accurate, especially with American species. Many timbers were (and are) known in the trade by vague generic terms such as rosewood or satinwood. Identification of the trees from which they come is not always easy even for expert botanists, of whom there were very few in tropical America 70 years ago. By the time Record & Hess published their *Timbers of the New World* in 1943 most of the difficulties had been cleared up (largely in Record's department at Yale), but some mythical toxic woods still live on from earlier days in much-copied lists (see *Ferolia* 55, *Rhodorhiza* 186, and probably *Coccoloba* 38).

France's principal contribution was to show that European timbers like oak and chestnut could also cause dermatitis, though more in forest-workers than carpenters and joiners. It was quickly found that the bark contained the bulk of the sensitizer, which was eventually traced to liverworts and lichens growing on the trees and undergrowth (Le Coulant & Lopès, 1956). The sensitizer has been identified as a sesquiterpene lactone (24). Most of the allergens in major commercial timbers have now been isolated and their structure determined, notably by workers in Hamburg in the last 15 years (Schulz & Dietrichs, 1962).

CLINICAL EFFECTS

Toxic woods, nearly always in the form of sawdust, may affect the skin or mucous membranes by direct contact or may be absorbed and produce general symptoms. The skin can be damaged by the mechanical action of bristles and splinters, by chemical irritation or sensitization, or by a combination of these. Photosensitization has not been proved but may well occur in the Rutaceae and Flindersiaceae.

Irritant dermatitis

Irritant chemicals are often found in the sap or latex, and are characteristic of certain families such as the Moraceae, Urticaceae, Euphorbiaceae and Apocynaceae. Some trees contain irritant powders in the bark or in cracks in the wood (brigalow 60, tagayasan 72, araroba 97). Both types of irritant, being confined largely to the outer part of the tree, produce their worst effects when it is felled, and are well known to local timber-workers. Sometimes the bark is burnt off before the tree is felled, or the trunk may be left for some time to dry before being sawn up. Very strong sensitizers, like those of the Anacardiaceae, affect so many workers that they are treated as irritants, though it is often known locally that some men are immune. Teak and some other woods are both irritants and sensitizers, even after seasoning, and this makes patch tests hard to interpret.

The clinical picture is that of any irritant dermatitis, with erythema and blistering of the exposed skin, often complicated by erosions and secondary infection in the poor hygienic conditions under which many lumbermen work and live (Freise, 1932-37; Suskind, 1967). The conjunctivae are often severely affected (manchineel 123, geor 125). Mild irritants may affect only susceptible areas such as the fingerwebs and corners of the mouth (Hornsey, 1914).

Sensitization dermatitis

Sensitizing chemicals are more often found among the extractives of the heartwood and therefore affect sawyers, carpenters and joiners, polishers and finishers exposed to fine dust. The picture is that of an airborne contact dermatitis, beginning on the dorsa of the hands and forearms, eyelids, face and neck, and rapidly involving the genitals through handling in micturition. In bald men the scalp is often affected. Longin (1929) emphasized the *triade éruptive* of hands, face and genitals in forest workers sensitive to liverworts on bark. If the clothing gives poor protection fine dust may drift inside it and affect the sweaty areas of the axillae, waistband and groins, and sometimes the ankles and dorsa of the feet.

Mild cases have only erythema and slight irritation, but often there is papular or vesicular dermatitis which may progress to chronic dermatitis after repeated exposure. Severe fissured lichenification of the palms was described as *mains de crocodile* by Morand (1907).

The latent period varies from a week to many years, but is most commonly 10–15 days (Touraine & Golé, 1934). In successive attacks it becomes shorter and the eczema usually increases in severity, but hardening is not unusual (Schwartz, 1931). Cross-reactions to other woods, or other sources of related antigens, are common (Merrill, 1944).

Dermatitis from the solid wood of finished articles is much less common, but has followed prolonged contact with musical instruments, bracelets or knife handles made of the strongly allergenic *Dalbergia* rosewoods (94). Furniture made of rengas (129) or obeche (146) can also give trouble.

Other skin lesions

Bristles or hairs from the bark, leaves or other parts of the tree sometimes irritate the skin (bamboo 18, palm 19, elm 25, ramin 157, dogwood 166) or mucous membranes (plane 54) of lumbermen and foresters. Even caterpillar hairs may be responsible (pine 7, acacia 60). Splinter wounds from a number of woods (Douglas fir 5, greenheart 44, acacia 60, afrormosia 83, limba 159, lancewood 163) are slow to heal and often become septic. It would be interesting to look in these for the granuloma formation characteristic of wounds from blackthorn spines (Buhr, 1960) and some cactus spines (Schreiber *et al.*, 1971). Folliculitis was described by Freise (1936) with several woods in Brazil, and by Salamone *et al.* (1969) with mansonia (147). Tagayasan (72) and araroba (97) sawdust stain the skin violet or brown, and white peroba (191) yellow. Tonka (99) and lapacho woods (190) can cause striking colour changes in the hair.

Oehling (1963) described contact urticaria as characteristic of obeche (146) sensitivity, but urticarial reactions have also been reported with larch (9) and iroko (32). Oehling was able to reproduce the urticaria within 5 min by rubbing the patient's skin with a slip of obeche but not with other woods. Many of the woodworkers he tested gave positive intradermal tests with obeche extract, even among those who did not get urticaria or asthma on exposure to the wood at work. Several substances have now been reported to cause contact urticaria (Maibach & Johnson, 1975), probably not always through an immune mechanism (Calnan & Shuster, 1963).

Mucosal irritation

Nasal irritation and sneezing are particularly common with certain woods (sequoia 10, western red cedar 13, sabicu 57, dahoma 62, sneezewood 109, guarea 117, mansonia 147, makoré 170, opepe 195), some of which have little or no effect on the skin. Dryness and soreness of the throat may extend to the larynx and trachea. Epistaxis and even haemoptysis may be conspicuous (stavewood 119, opepe 195) and headache is common. Nausea may lead to vomiting and anorexia lasting several days (stavewood 119, Knysna boxwood 183). Conjunctivitis usually accompanies nasal irritation but it is also characteristic of some skin reactions (lichens 24, araroba 97).

Irritation of the upper respiratory tract is generally found in most of the workers exposed, but asthma affects only a minority. It has been described with sawdust of western red cedar (13), iroko (32), amboyna (93), box (127), obeche (146), teak (188), and less often with a number of other woods. Attacks of asthma may be delayed for several hours after exposure to the sawdust, which sometimes obscures the diagnosis (Gandevia & Milne, 1970). Inhalation tests are more reliable than scratch or intradermal tests, which give both false positives and false negatives (Sosman *et al.*, 1969). Desensitization by injections of kejaat extract (93) was successful in the hands of Ordman (1949b), but has proved disappointing with most woods.

Gade (1921) maintained that carpenters often suffered from asthma due to beech sawdust and had a high mortality from respiratory disease. This was denied by Vallander (1950), who found only one case of asthma and one with radiographic pulmonary infiltration among ninety men with at least 10 years' experience in woodworking. There are a few woods, however, which cause recurrent bronchitis or pneumonitis leading to chronic lung damage (sequoia 10, cork oak 24, maple 141).

Acheson *et al.* (1968) found a much increased incidence of adenocarcinoma of the paranasal sinuses in English woodworkers and there are similar reports from France (Fombeur, 1972). Black *et al.* (1974) tested nasal mucociliary activity in woodworkers and found considerable impairment, especially in men with over 10 years' exposure to dust. No particular wood or constituent has been incriminated, but Schoental (1973) showed that some unsaturated carbonyl compounds in lignins were carcinogenic for rats. The evidence for a connection between woodworking and Hodgkin's disease in the U.S.A. is less convincing (Milham & Hesser, 1967; Acheson, 1967; Spiers, 1969). Pine pollen is not now thought to be a significant cause of sarcoidosis (Scadding, 1967), though it is allergenic and can produce sarcoid-like granulomas in experimental animals.

Systemic symptoms

Headache, salivation, thirst and nausea are sometimes too severe to be explained by simple mucosal irritation (red peroba 179, Knysna boxwood 183). Giddiness, drowsiness, visual disturbances, colic, muscle cramps and cardiac arrhythmia suggest the effects of alkaloids or glycosides absorbed through the respiratory or alimentary tracts, or occasionally through skin abrasions. Pharmacologically active substances have been demonstrated in the bark or wood of many trees known to have such effects (barberry 39, missanda 65, ferro 71, sophora 85, laburnum 88, wenge 90, Knysna boxwood 183, opepe 195). Dixon (1911) thought the amounts absorbed would be so small that there must be an 'idiosyncrasy' rather than simple pharmacological action, but the incidence of these effects is generally too high for an allergic mechanism.

In the days when food was eaten from wooden containers and implements it was common knowledge that certain woods did not taint the food (see spindle-tree 140, dogwood 166). Others were avoided because they contained strongly flavoured extractives such as turpentine (Boulger, 1906). In exceptional cases poisoning was recorded from containers, spoons or spits made of woods like yew (2) or oleander (184) which harbour toxic alkaloids.

WOOD CHEMISTRY

The structural components of wood are cellulose, hemicellulose and lignin, but it is the accessory substances or 'extractives' found mainly in the heartwood that are responsible for most toxic effects. Vorreiter (1949/1958) classifies these as follows: (1) fats, resins, oils and waxes; (2) proteins, gums, latex, mucus, starch, sugars; (3) alkaloids, bitter principles, dyes, tannins, glycosides, camphor, perfumes, etc.; (4) inorganic and organic acids and salts; (5) minerals.

Some of these act as food reserves for latent growth periods, some as hardening agents, and others

protect against mechanical injuries or attack by bacteria, fungi, insects and larger animals (Dietrichs, 1958). Some are metabolic by-products or end-products of no apparent use to the tree.

TOXIC SUBSTANCES

Alkaloids and **glycosides** were among the first substances isolated and studied by plant chemists, though establishment of their complex structures often had to wait till recent times. Those of no medical or economic importance are still largely undetermined. Systemic effects, pharmacological rather than allergic, are characteristic of these substances, which have been found in many toxic woods and barks (pigeon plum 38, greenheart 44, mesquite 61, missanda 65, ferro 71, basralocus 74, wenge 90, guatambu 104, Ceylon satinwood 108, avodiré 118, red peroba 179, Knysna boxwood 183, opepe 195, abura 196) as well as those shown in Fig. 1. The structure of the taxines (from yew 2) is complex (Merck, 1968).

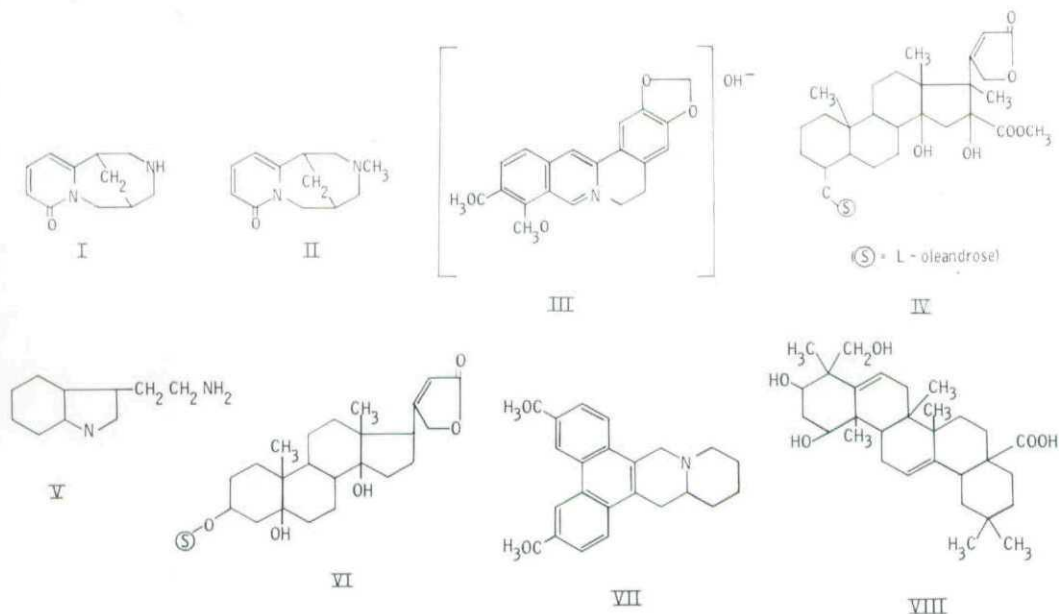


FIGURE 1. Alkaloids, glycosides, saponins. I. Cytisine; II. *N*-Methyl cytisine; III. Berberine; IV. Oleandrin; V. Tryptamine; VI. Periplocin; VII. Cryptopleurine; VIII. Basic acid (aglycone of makoré-saponin).

Saponins are found in large quantities in the wood of satine (29) and in smaller amounts in many others (albizia 56, vinhatico 64, black bean 81, mahua 167, makoré 170, etc.). The aglycone of makoré saponin is shown in Fig. 1. Saponins are haemolytic when given parenterally and are sometimes used in arrow poisons. They irritate mucous membranes but do not penetrate unbroken skin.

Many of the strongest skin-sensitizers are found among the **phenols** (Fig. 2), especially the **catechols** of the poison-ivy family (128). The only other families in which similar phenols are commonly found are the Proteaceae (35) and Ginkgoaceae (17), which are surprisingly distant taxonomically from the Anacardiaceae.

Some active **quinones** (Fig. 3) from woods have been known since the nineteenth century. Lapacho is found mainly in the Bignoniaceae (190, 191) but also in teak (188) and some other woods. Chrysophanic acid used to be extracted from *Vataireopsis* (97) in the form of chrysarobin for treating psoria-

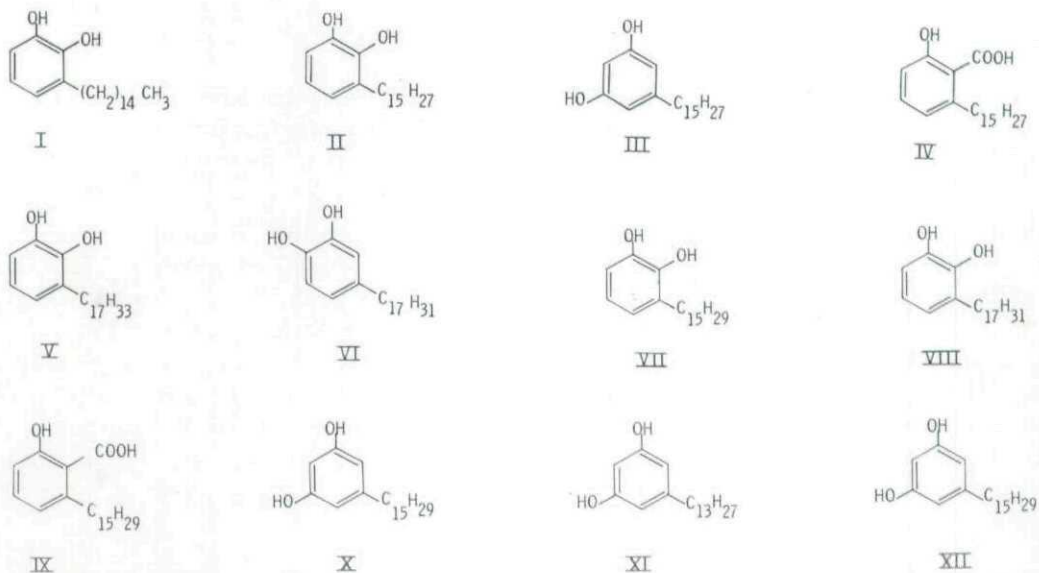


FIGURE 2. Phenols. I. 3-Pentadecylcatechol (hydrourushiol); II. Urushiol (8,11,14 tri-enyl in *Rhus toxicodendron*, 8,11,13 tri-enyl in *R. vernicifera*); III. Cardol; IV. Anacardic acid; V. Glutarenghol; VI. Thitsiol; VII. Renghol; VIII. Laccol; IX. Ginkgolic acid; X. Bilobol; XI. Grevillol; XII. 5-(10-Pentadecenyl)resorcinol.

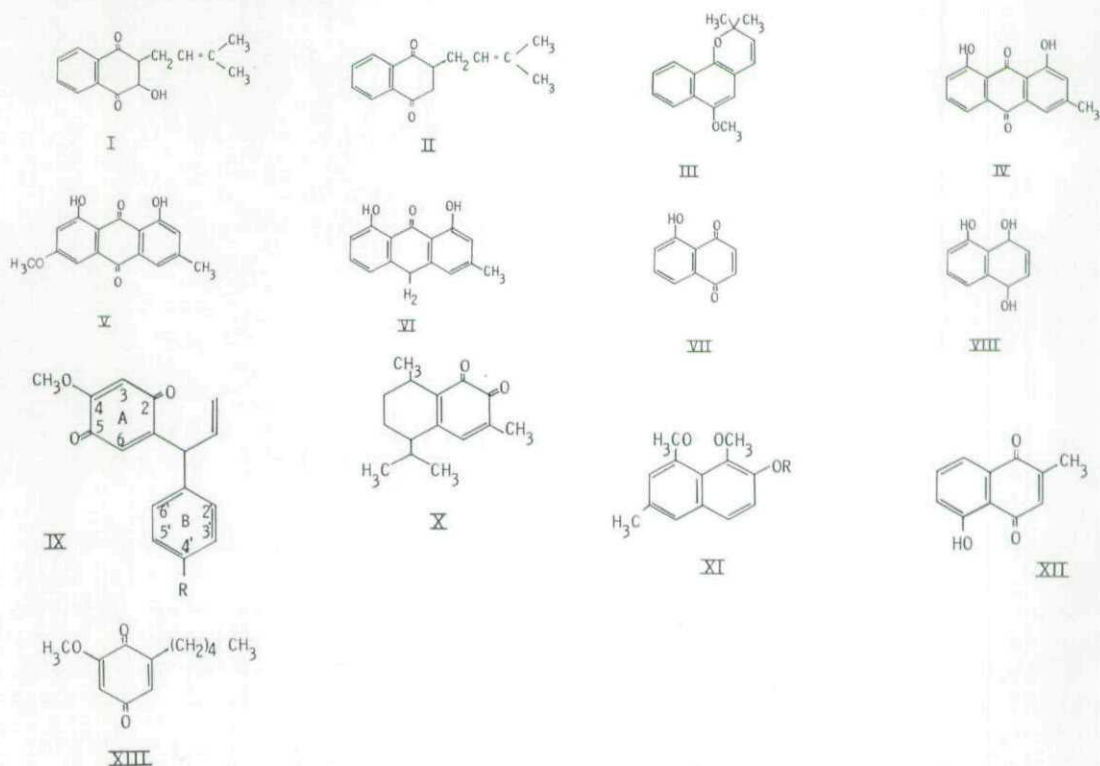


FIGURE 3. Quinones and related substances. I. Lapachol; II. Desoxylapachol; III. Lapachenol (lapachonone); IV. Chrysophanic acid; V. Physcion; VI. Chrysophanic acid anthrone; VII. Juglone; VIII. α -Hydrojuglone; IX. Dalbergiones (4-methoxydalbergione: R = H; 4,4'-dimethoxydalbergione: R = OCH₃; 4'-hydroxy 4-methoxydalbergione: R = OH); X. Mansonone-A; XI. Makassars (makassar II: R = H; makassar III: R = CH₃); XII. Plumbagin; XIII. Primin.

sis, and it is also found in *Vatairea* (98) and tagayasan (72). In both cases the active agents are not the quinones themselves, but the less stable related substances, desoxylapachone and chrysophanic acid anthrone. Juglone, or its precursor α -hydrojuglone, is found in the sensitizing shells of walnuts (21) but not in the wood. Plumbagin is a strongly irritant quinone found in the bark of some *Diospyros* spp. (173).

Recently other groups of allergenic quinones have been demonstrated in mansonia (147) and the *Dalbergia* rosewoods (94), the dalbergiones in particular being very strong sensitizers which have also been found in some other woods (purpleheart 68, angelin 96). The macassars found in ebony

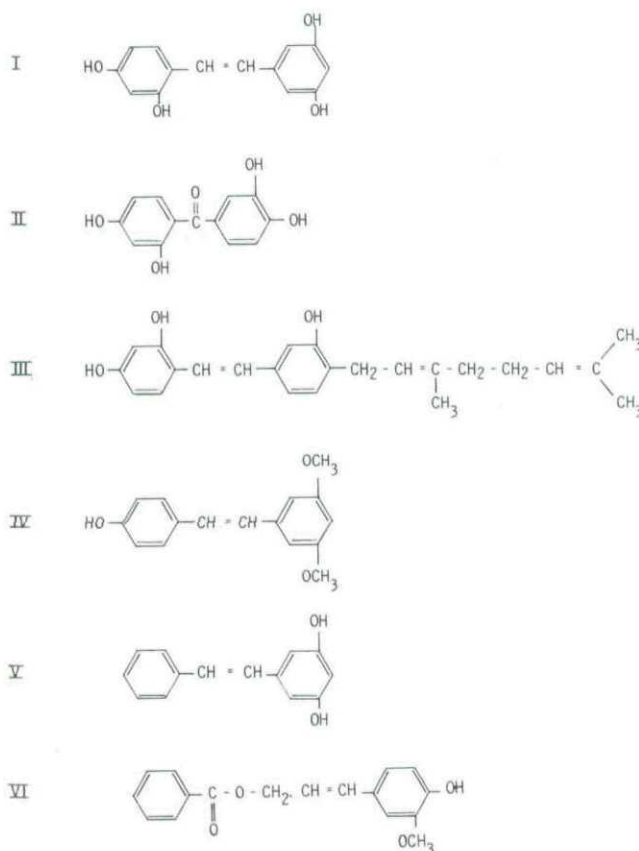


FIGURE 4. Stilbenes. I. 2,3,4,5' tetrahydroxystilbene; II. Maclurin; III. Chlorophorin; IV. Pterostilbene; V. Pinosylvine; VI. Coniferyl benzoate.

heartwood (173) can easily be oxidized to quinones, but these are not yet known to sensitize (Hausen, 1970). Hausen and other German workers have demonstrated but not yet identified possible skin-sensitizing quinones in other woods (American whitewood 41, sucupira 82, cocus 91, Jamaica quassia 110, *Cordia* spp. 187).

Primin, the sensitizer in *Primula obconica*, was shown by Schildknecht *et al.* (1967) to be a quinone not unlike the *Dalbergia* quinones (Fig. 3), and cross-reactions between them have been observed by Hjorth *et al.* (1969).

A number of **stilbenes** (Fig. 4) occur in allergenic woods, but only chlorophorin (iroko 32) and

coniferyl benzoate (Peru balsam 84) are known to sensitize. **Terpenes** (Fig. 5) include delta-3-carene from turpentine (pine 7, etc.), sesquiterpene lactones in *Frullania* and other sensitizing liverworts found on bark (24), and euphorbol and other complex terpenes of uncertain toxicity found in the latex of Euphorbiaceae (122).

The photosensitizing **furocoumarins** (Fig. 6) are widespread in the Rutaceae and Flindersiaceae and may be at least partly responsible for skin reactions to woods of these families (West Indian, African and Ceylon satinwoods 103, 108), but this has not yet been proved. Bergaptene (8-methyl psoralen), the cause of berloque dermatitis, was first obtained from the peel of the Bergamot orange (*Citrus aurantium* var. *bergamia*; 106). The latex of fig trees also contains a photosensitizing furocoumarin (Kuske, 1939).

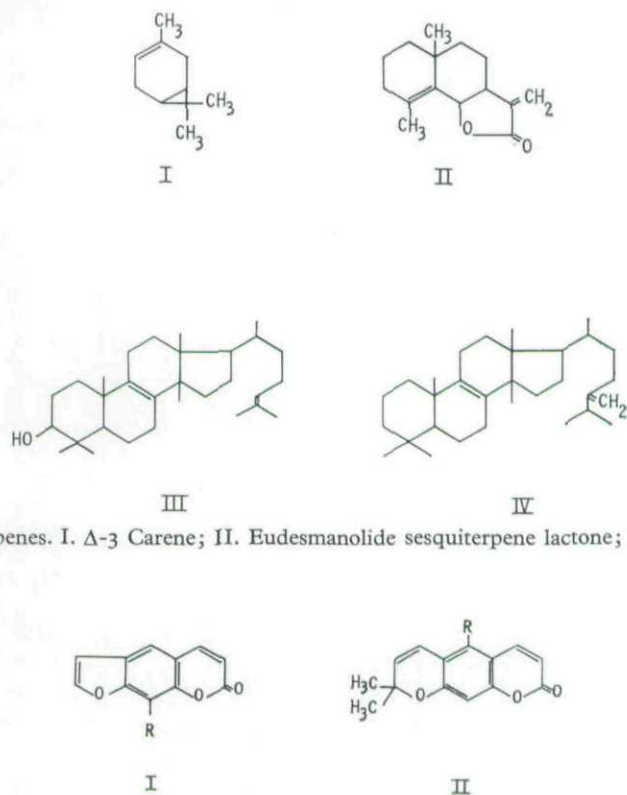


FIGURE 5. Terpenes. I. Δ^3 Carene; II. Eudesmanolide sesquiterpene lactone; III. Euphol; IV. Euphorbol.

FIGURE 6. Coumarins. I. Psoralen (R = H); 8-Methylpsoralen (R = CH₃); xanthotoxin (R = OCH₃); II. Xanthyletin (R = H); xanthoxyletin (R = OCH₃).

The formulae of some other known or suspected sensitizers are shown in Fig. 7.

Reference has been made to sensitizing substances penetrating into wood from liverworts and lichens on the bark. Many other chemicals are introduced into timber while it is being processed. Preservatives such as pentachlorophenol and other chlorinated phenols (Schwarzkpof, 1954; Fournier, 1965; Crow, 1970); potassium dichromate (Grossmann, 1920; Behrbohm, 1957); urea-formaldehyde- and epoxy- resins, turpentine, polishes, varnishes and dyes (Meneghini & Rubini, 1958; Hering, 1966) cause much more dermatitis in woodworkers than the woods themselves (Suskind, 1967; Tan & Mitchell, 1968).

DIAGNOSIS

The first step is to establish what timbers and additives the patient has been exposed to. The full trade name of each timber is necessary, together with the country of origin. Whenever possible wood samples (not sawdust) should be sent to experts for identification; the staff of Forest Products Research Laboratories, Institutes of Forestry and Botanical Gardens are often helpful beyond the call of duty.

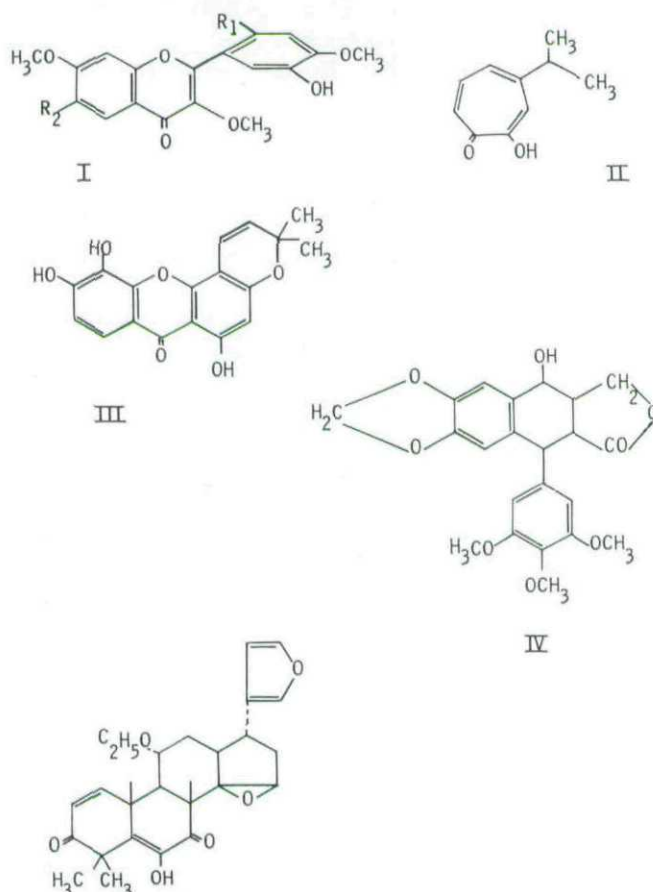


FIGURE 7. Other substances. I. Ayanin ($R_1 = OH$, $R_2 = H$); oxyayanin-A ($R_1 = OH$, $R_2 = H$); oxyayanin-B ($R_1 = H$, $R_2 = OH$); II. β -thujaplicin (tropolone); III. Jacareubin (xanthone); IV. Podophyllotoxin (picropodophyllin is a stereo-isomer); V. Anthothecol.

With known irritants such as mansonia (147) further investigation is unnecessary if the symptoms produced are typical. Where skin sensitization is suspected, however, patch tests should be made with fine sawdust (to avoid mechanical irritation). Moistening of the sawdust is advisable except with teak where it leads to false positive results. Positive tests with woods not known to be sensitizers should be checked by several tests on control subjects. Patch testing with the pure sensitizing substances, where known, is not yet practicable in routine diagnosis.

Bronchial sensitivity is best examined by inhalation tests with aqueous extracts of the sawdust, adequately controlled. Prick tests and intradermal tests are unreliable and difficult to interpret. Circulating antibodies have been demonstrated in some cases (sequoia).

PROPHYLAXIS

Compared with other trades, woodworking does not carry a high incidence of industrial dermatitis (Zschunke, 1963), and most of the trouble that does occur is due to additives rather than the wood itself. Although the numbers are small, however, the circumstances may be dramatic when a traditional wood is replaced by a substitute and many workers are smitten at once by an unfamiliar toxic substance. Complete prevention of such outbreaks is hardly possible, with the constantly shifting pattern of timber imports and the difficulty of identifying logs and especially sawn timber. The manufacturer and even the shipper may be unaware of a few toxic logs among harmless ones (see *Machaerium* 95, *Vatairea* 98).

Some timbers like teak, mansonia and rosewoods have such valuable properties that they are still used despite their known toxicity. The main preventive measures with such woods are dust control, protective clothing, hygiene, barrier creams and personnel selection.

(1) *Dust control.* Hanslian & Kadlec (1964a) showed that mechanical polishing produced on average 40 mg (maximum 200 mg) per cubic metre of wood dust in the surrounding air, and that 90% of the particles were less than 5 μm in diameter. They recommended that the maximum permitted level should be 1 mg/m³ for 'toxic' woods such as yew, box and mansonia; 5 mg/m³ for moderately active woods like pine, larch, ebony and mahogany; and 10 mg/m³ for other woods. The American Conference of Governmental Industrial Hygienists recommended in 1970 that not more than 5 mg/m³ should be allowed, and this was the average found in High Wycombe factories by Hounam & Williams (1974), though there were some much higher levels. Baumer (1955) describes and illustrates methods of exhaust ventilation suitable for vertical moulders, polishers, circular saws and other machines. There is good evidence of the efficiency of exhaust ventilation in general (Krogh, 1964), but it is less effective with certain processes (Legge, 1907) and with very fine dusts. Moistening the air is sometimes helpful (Komatsu, 1963).

(2) *Protective clothing* includes a high collar, long sleeves and when practicable gauntlets for skin-irritants, and masks for mucosal irritants. It tends to be neglected in hot conditions when increased sweating also makes men more vulnerable.

(3) *Washing facilities* should include showers where there is a risk of dust getting under the clothes.

(4) *Barrier creams* are more popular with lawyers than doctors. Even when they are not irritating in themselves, manual work quickly removes them from the exposed areas of skin which are most at risk.

(5) *Nasal sprays* with antihistamines were found useful against the very irritating dust of *Thuja standishii* (13) by Komatsu (1963), but they would hardly be suitable for prolonged use.

(6) *Personnel selection* is to some extent automatic as men who know they are sensitive to certain woods can usually avoid them, management being co-operative in a craft industry. Prospective patch-testing before employment is unreliable, and there is a risk that the test itself may sensitize the man.

PREVIOUS REVIEWS OF TOXIC WOODS

Reviews written before about 1930 are apt to be unreliable both botanically and chemically. Touton's (1932) exhaustive but not always critical monograph on plant dermatitis in Jadassohn's Handbuch

is still useful for older references. Senear (1933) and Rasch (1935) wrote reviews in English which are now of mainly historical interest. Local studies exist for Australia (Cleland, 1914, 1925, 1932), Brazil (Freise, 1932, 1936, 1937), Malaya (Ridley, 1922; Burkill, 1935), Panama (Allen, 1943) and India (Behl & Captain, 1966).

Sandermann & Barghoorn's (1956) well-documented review has been superseded by Hausen (1970), who is particularly strong on wood chemistry. Unfortunately Hausen's comprehensive thesis is difficult to obtain, but he has published an abridged version without references (Hausen, 1973).

There are also a number of reviews which consist of little more than lists of supposedly toxic woods, without adequate documentation. Many woods have found their way into such lists on quite insufficient evidence or through mistaken identity. Some of them have been included in the present review simply to demonstrate the lack of evidence against them. Where there are convincing clinical details and/or patch tests, they have always been mentioned here. Known chemical constituents of each wood are generally given only if there is reason to think they are toxic.

Willis (see below) has been followed for botanical nomenclature and also for the order of families (Engler system) and genera. Closely related trees should therefore usually be found close together here, though there is of course still much disagreement among taxonomists, especially over the larger groups. British Standard names of timbers are printed in **bold**, and international *noms pilotes* from the Nomenclature Générale shown by (NP). (See below).

BOTANICAL AUTHORITIES

British Standard Nomenclature of Commercial Timbers. B.S. 881 and 589 (1955) in: Commonwealth Forestry Handbook (1962), Empire Forestry Association, London.

Nomenclature Générale des Bois Tropicaux (1965) Association technique internationale des bois tropicaux, Nogent-sur-Marne.

A Dictionary of the Flowering Plants and Ferns (1966) WILLIS, J.C., rev. AIRY SHAW, H.K. 7th edn. Cambridge University Press.

Handbook of Hardwoods (1972) rev. FARMER, R.H. 2nd edn. Ministry of Technology, HMSO, London.

Handbook of Softwoods (1957) Ministry of Technology, HMSO, London.

World Timbers (1969) RENDLE, B.J. Benn, Toronto and London.

The Structure of Wood (1970) JANE, F.W. 2nd edn, rev. WILSON, K. & WHITE, D.J.B. Black, London.

GYMNOSPERMAE: CONIFERAE Softwoods

PODOCARPACEAE

1. *Dacrydium cupressinum* Soland. Rimu

The sawdust of this New Zealand wood causes temporary spasmodic rhinorrhoea in some workers (Cleland, 1925).

TAXACEAE

2. *Taxus baccata* L. Yew

A keen archer had severe dermatitis on the face, neck, hands and forearms each time he scraped his bow (Senear, 1933). He patch-tested himself with moist sawdust from the bow and from the block of English yew it was made of, with positive results. Grossmann (1920) had experienced mild headache and discomfort while working with yew, as had other workers with him. Moll (1950) says that it irritates the respiratory passages as well as the skin, but quotes no cases.

Most parts of the tree, including the wood, contain the series of alkaloids called taxines which are responsible for yew's internal toxicity (Merck, 1968; Hausen, 1970), but there is also an irritant volatile oil (Forsyth, 1968).

Pliny's story of travellers in Gaul poisoned by wine from hip-flasks made of yew-wood is always quoted, but there is little from more reliable sources. Poisoning of men and cattle by yew leaves is of course well known.

ARAUCARIACEAE

3. *Araucaria angustifolia* O. Ktze. **Parana pine**, pin parana (NP),
(*A. brasiliana* A. Rich.) araucaria

A trade report of fever, weakness and muscle pains after working with Parana pine was not investigated clinically, but the wood was found to contain at least two alkaloids (Hausen, 1970). One St John's patient gave a positive patch test with Parana pine (211).

PINACEAE

4. *Picea sitchensis* Carr. **Sitka spruce**, silver spruce
P. abies Karst. **European spruce**, whitewood
(*P. excelsa* Link.)

Women cutting up and sandpapering silver spruce in an aircraft factory developed irritating vesicles on the hands (Prosser White, 1920). Fregert & Rorsman (1963) saw a case of contact sensitivity to the balsams of pine and spruce, and found many unexplained positive results when these were included in routine patch tests. Cross-reactions with stilboestrol suggested that hydroxystilbenes might be responsible (but see 7). Bahn (1928) obtained strongly positive intradermal tests with spruce and pine wood extracts in a sawmill worker with asthma; oak and beech gave weaker reactions and control subjects were negative. Cobe (1930) had two asthmatic

patients who became sensitive to the needles of *P. mariana* B.S.P. (black spruce), with positive intradermal tests.

One St John's patient gave positive patch tests with spruce and with casein glue (215).

5. *Pseudotsuga menziesii* (Mirb.) Franco
(*P. taxifolia* Britt.)

Douglas fir, Oregon pine,
British Columbia pine

A messenger at the Forest Products Research Laboratory with slight exposure to many woods developed severe dermatitis on exposed skin. Patch tests were strongly positive with Douglas fir and negative with several other woods (Wilkinson, 1971). Suskind (1967) patch-tested eighty-two British Columbia lumber workers with eczema of the hands, and found two reacted to an extract of Douglas fir wood and one to grand fir (6). There are many trade complaints of septic splinter wounds (Nordin, 1947; FPRL, 1963). Neudörffer's (1902) case of general symptoms after wreath-making with Douglas fir is not convincing.

The wood contains α -pinene and the resin thunbergol and Δ -3-carene (Hancock & Swan, 1965).

6. *Abies alba* Mill.
(*A. pectinata* DC.)
A. grandis Lindl.

Silver fir, whitewood

Grand fir, white fir, western
balsam

A. balsamea (L.) Mill.

Balsam fir

Ganzoni (1929) described eczema of the hands and arms spreading to the face and neck, which recurred each winter in farmers who felled and sawed silver fir at that season only. Patch tests with fir resin were strongly positive. One of Suskind's lumbermen (see 5) gave positive patch tests with the bark and leaves of grand fir, but not with the wood. Some firs have sensitizing lichens or liverworts (see 24) growing on their bark (Tenchio, 1948). Kappes (1948) described contact dermatitis (with positive patch test) in a florist, from the foliage of balsam fir (the tree which produces Canada balsam). Siemens (1929) reported dermatitis from the foliage of silver fir, but made no patch tests. Twelve cases of contact dermatitis from 'fir' wood were seen at the Finsen Institute between 1935 and 1963 (Hjorth, 1965).

7. *Pinus sylvestris* L.
P. pinaster Ait.
P. palustris Mill.

Scots pine, redwood, red deal

Maritime pine, cluster pine

Pitch pine

Peri (1910) described irritation of the hands by shavings of maritime pine used in working cast iron. Wilkinson (1971) has seen five cases of contact dermatitis in carpenters, who had positive patch tests with sawdust and extracts of pine wood. It is not known whether the sensitizer is a stilbene such as pinosylvine (King, 1953) or a balsam element like Δ -3-carene (Pirilä *et al.*, 1964) or coniferylbenzoate (Figs 4 and 5).

Woodcutter's eczema (24) occurs in pinewoods, either from lichens on conifer bark or liverworts on undergrowth (Le Coulant *et al.*, 1966). Katzenellenbogen (1955) described dermatitis in Israeli foresters working on pines infested with the caterpillar *Thaumtopoea pinivora*. Patch tests were positive with caterpillar hairs (irritation) but negative with the pulped cocoon. Allergy to pine pollen is not now considered a significant aetiological factor in sarcoidosis (Scadding, 1967).

There is no evidence that pitch pine is toxic. Hausen (1970) showed that it had been included in some lists through a blunder over the name.

Six St John's patients gave positive patch tests with pine or 'deal' (210).

8. *Cedrus deodara* (Roxb. ex Lamb.) G.Don Deodar
(*C. libani*, *Pinus deodara*)

The oil extracted by distillation of the wood is used as an insect repellent and antiseptic (Gamble, 1902), but the wood, sap and cones can irritate the skin (Behl & Captain, 1966).

9. *Larix decidua* Mill. European larch
(*L. europea* DC.)

Hanslian & Kadlec (1964) described contact urticaria from larch sawdust with positive patch tests. Chromatography showed Δ -3-carene and other terpenes in the wood (Fig. 5). Schulmann & Détouillon (1932) and Tenchio (1948) included larch among the trees that cause wood-cutter's eczema (24).

TAXODIACEAE

10. *Sequoia sempervirens* Endl. Sequoia, Californian redwood

Oliver (1902) described coryzal symptoms in men sawing and chipping sequoia wood. They complained of running at the nose, sneezing, coughing, laboured breathing, oppression at the pit of the stomach and smarting in the eyes, and were noted to have tachycardia. The symptoms were worst on the first exposure and lasted about 24 h, but tolerance later developed except in asthma subjects. Oliver put the sawdust into animals' cages; rabbits were unaffected, but some rats ran at the nose.

MacPherson (1925b) reported similar symptoms in Australian cabinet-makers. Cohen *et al.* (1967) described a case of chronic granulomatous pneumonitis (sequoiosis) with circulating antibodies to redwood sawdust (or possibly to an associated fungus) in a sawmill worker.

CUPRESSACEAE

11. *Callitris* spp. Cypress pine

Cleland (1925) quoted a very brief reference to dermatitis caused by cypress pine cut when in flower. *C. articulata* contains thymoquinone (see 12).

12. *Calocedrus decurrens* (Torr.) Florin Incense cedar (California)
(*Libocedrus decurrens* Torr.)

Calnan (1972) reported two cases of pencil dermatitis, one on the hand in a clerk and the other behind the ear in a carpenter. Patch tests with shavings from the pencils were positive, and one patient was also positive to extracts of incense cedar and western red cedar (13). Both reacted strongly to 1% thymoquinone and hydrothymoquinone, but a primary irritant effect was not ruled out. Neither reacted to β -thujaplicin.

Incense cedar heartwood contains carvacrol, p-methoxythymol, p-methoxycarvacrol, terpenes, α -thujaplicin and small amounts of β -thujaplicin and β -thujaplicinol as well as thymoquinone and hydrothymoquinone (Anderson & Zavarin, 1955). Incense cedar and Virginian pencil cedar are officially recognized causes of dermatitis in the German pencil industry (Koelsch, 1931).

13. *Thuja plicata* D. Don

Western red cedar, beisugi, giant arbor vitae

T. standishii Carr.

Arbor vitae, nezuko

T. standishii is an important timber in Japan, where its fine dust causes rhinitis in almost 90% of workers and asthma in a smaller number (Komatsu, 1963; Ito, 1963). Ito found *T. plicata* rather less troublesome to woodworkers, but there were a number of cases of 'beisugi asthma' among people living in houses rebuilt with it after the 1923 Tokyo earthquake (Hausen, 1970). Doig (1949) described asthma from *T. plicata* sawdust in England, and Gandevia & Milne (1970) reported in detail six cases of asthma and four of rhinitis in Australian woodworkers. The asthma often came on at night several hours after exposure to the dust, and would persist for some days after avoiding it (Mitchell, 1970). Skin tests were unreliable, but bronchial inhalation tests were positive, and the F.E.V. was slightly reduced on working days even in men without clinical asthma (Gandevia, 1970).

Bleumink & Nater (1972) described a case of dermatitis in a sawyer who gave strongly positive patch tests with western red cedar and a weak positive with deal. γ -Thujaplicin gave a strongly positive reaction, and another tropolone a delayed positive. The FPRL (1963) receives many trade complaints of skin as well as mucosal irritation, but no other case reports of dermatitis have been found.

Bridge (1937) described severe nasal irritation produced in one man, and possibly bronchitis in two others, by the sawdust of 'Canadian red cedar'. This is more likely to have been *T. plicata* than *Juniperus virginiana* (eastern red cedar).

Ito (1964) sensitized guinea-pigs with β -thujaplicin, but it is still not clear whether this is the cause of asthma in humans (Chan-Yeung *et al.*, 1971).

Thuja occidentalis L.

White cedar, eastern arbor vitae

Sachs (1926) described dermatitis of the hands affecting several men working with white cedar; another man had pharyngitis and bronchitis but no dermatitis.

14. *Cupressus sempervirens* L.

Cypress

Ramazzini (1700) remarked that some turners suffered from headaches due to the strong smell of cypress wood. Lewith (1929) reported transient erythema from a patch test with cypress sawdust in a man sensitive to palisander. No other cases have been found, but the wood is now rarely used. It is known to contain beta-thujaplicin and several terpenes (Enzell & Erdtman, 1957).

15. *Chamaecyparis lawsoniana* Parl.
(*Cupressus lawsoniana* A. Murr.)

Port Orford cedar,
Lawson's cypress

Asthma due to cedar wood has been described on the west coast of the U.S.A. (Schonwald,

1929; Stier, 1929). Prosser White (1929) found splinter wounds from it were slow to heal. The powerful resinous odour of the newly-cut wood was said to cause troublesome diuresis in saw-mill workers (Sargent, 1896).

None of Hausen's references for contact dermatitis from the wood is convincing on scrutiny. Unlike most Cupressaceae, Lawson's cypress contains very little beta-thujaplicin and no other tropolones (Zavarin *et al.*, 1959).

16. *Juniperus sabina* L.

Savin, savinier (NP),
sabinenwacholder

J. oxycedrus L.

Cade

J. virginiana L.

Virginian pencil cedar, eastern
red cedar

Moll (1950) seems to follow Grossmann (1920) in listing savin as toxic, but no reports of ill-effects from this little-used wood have been found. Oil of cade from the berries of *J. oxycedrus* is irritant, and also sensitizes some patients (White, 1887; Gougerot & Blamoutier, 1922a). The leaves of most junipers are irritant (White, 1889) and the pollen of *J. mexicana* Spreng. is a common cause of hay fever in Texas (Wodehouse, 1971).

J. virginiana is an officially recognized cause of dermatitis in Germany (see 12). Cedarwood oil from this species has been suspected of phototoxicity (Opdyke, 1974).

GINKGOALES

GINKGOACEAE

17. *Ginkgo biloba* L.

Maidenhair tree

The pulp of the berries can cause contact dermatitis (Bolus, 1939). The ginkgolic acid and bilobol responsible (Fig. 2) are similar to the sensitizing catechols in *Rhus* spp. and may cross-react with them (Sowers *et al.*, 1965). Dermatitis from the little-used timber has not been reported.

ANGIOSPERMAE

Hardwoods

GRAMINEAE

18. *Bambusa vulgaris* Schrad. et spp. (and other genera)

Bamboo

The bristles on the leaf and stem sheaths are known to be irritating (Ridley, 1924; Allen, 1943), but Schiff (1951) reported dermatitis in workers sanding bamboo stems from which the bark and hairs had been removed. Patch tests with bamboo shavings were positive, but no control subjects were tested.

PALMAE

19. *Astrocaryum* spp., *Bactris* spp., etc.

Palms

Freise (1937) described dermatitis of the arms and general symptoms in men working with palm wood in Brazil. Patch tests with a wax extracted from the wood were positive. The leaf-spines and fruit irritate the skin (Allen, 1943).

Cocus or cocos wood (91) has nothing to do with the coconut palm (*Cocos nucifera* L.).

SALICACEAE

20. *Populus albus* L.
P. carolinensis Foug.
P. gileadensis Rouleau

White poplar, abele
Carolina poplar, carolin
Balm of Gilead

Winkler (1956) described two cases of dermatitis in woodmen who had been in contact with resin from white poplar buds. Patch tests with the resin and with turpentine were positive on both men and negative on two controls. A less convincing case of dermatitis from the sawdust of an unspecified American poplar was reported by Weber (1953). Poplar is one of the trees listed by Schulmann & Détoillon (1932) as causes of woodcutter's eczema (24). According to Le Coulant *et al.* (1966) enough allergen soaks into the wood from liverworts on the bark to sensitize workers making match splints from 'carolins d'Italie' (*P. carolinensis* or a hybrid?) in southern France.

Dermatitis due to balm of Gilead was well described by White (1887), when it was a common domestic salve obtained from *P. gileadensis* in the U.S.A.

JUGLANDACEAE

21. *Juglans regia* L.
J. nigra L.

European walnut
American walnut, black walnut

The nutshells of both species stain the skin dark brown and can cause dermatitis. A German report (Barniske, 1957) suggested sensitization, but an American one (Siegel, 1954) favoured a primary irritant effect. The active substance is probably the xanthoquinone juglone (Fig. 3), a precursor of which is found in the nutshells, roots and bark, but not in the wood (Brissemoret & Combes, 1905; Hausen, 1970). No case reports of skin or mucosal irritation by the wood have been found. One man at St John's gave a positive patch test with *J. regia* veneer, but he reacted to so many woods and other allergens that the significance of the tests was doubtful (218).

BETULACEAE

22. *Alnus glutinosa* Gaertn.

Common alder, black alder

Brügel & Perutz (1927) described dermatitis of the face and hands in workers using black alder from Russia. Patch tests with the wood, sawdust, aqueous and alcoholic extracts and alder tannin were positive in all four and negative in controls. Cross-reactions with catechu, rheum and hamamelis suggested that the sensitizer was a catechol in the tannin. Dässler & Urzynicko (1958) extracted and purified the yellow crystalline tannin from black alder bark, and obtained negative patch tests on forty-one people. Only two of these had had alder dermatitis, however, and it was not stated how long ago.

23. *Betula papyracea* Ait.
(*B. papyrifera* Marsh.)

Paper birch, white birch,
American birch (in part)

Senear (1933) quoted a report in a trade journal that workmen in mills where paper birch logs were used often had a skin eruption due to the fine powder on the bark.

FAGACEAE

24. *Fagus sylvatica* L.
Quercus robur L. et spp.
Castanea sativa Mill.

Beech
Oak
Sweet chestnut

Horand (1907) gave the name 'mains de crocodile' to chronic fissured hyperkeratotic eczema of the hands in woodmen working with chestnut, which he attributed mainly to tannin. Spillmann (1921) described dermatitis on the ear and side of the neck in a man who had carried freshly-cut oak logs on his shoulder, and suggested that fungi on the bark might be responsible. Tommasi (1929) reported similar cases from Italy and suspected an 'idiosyncrasy' because an attack often followed returning to work with wood after an interval. Dubreuilh (1931) described six cases of 'woodcutter's eczema' and again emphasized the role of the bark. Schulmann & Détouillon (1932) distinguished between chronic lichenified eczema of the hands, perhaps due to resin, and acute 'sylvestro-sensibilization' of face, hands and genitals. Conjunctivitis was often associated (Lagrange, 1923). Oak, beech, chestnut, poplar, acacia (*Robinia*), plane, elm and conifers could all cause dermatitis. At this point Senear (1933) reviewed the position in detail.

Tenchio (1948) took matters a stage further by getting positive patch tests with *Parmelia caperata*, a lichen he found growing on the bark of firs, larches and chestnuts. Ghillini (1954) reported dermatitis from the same lichen growing on oak and ilex. Le Coulant & Lopès (1956) found that other lichens and mosses also contained the allergen, but much the strongest reactions were obtained with *Frullania* and other liverworts of the family Jungermanniales. These liverworts are found on the bark of most deciduous trees in S.W. France, and on undergrowth and rocks even among conifers, on the bark of which lichens prevail. In their review Le Coulant *et al.* (1966) concluded that liverworts were the main cause of woodcutter's eczema, and were in fact responsible for 2-4% of all contact dermatitis in that part of France. According to Philippe *et al.* (1965) they also cause rhinitis, asthma and urticaria, with positive intradermal tests. Knoche *et al.* (1969) showed that sesquiterpene lactones (Fig. 5) similar to those widespread in the Compositae were the sensitizers in *Frullania tamarisci*.

Mitchell (1965) investigated 'cedar-poisoning' in British Columbia lumbermen, obtaining positive patch tests with bark lichens and the usnic acid they contain, but negative results with the wood itself (Mitchell & Armitage, 1965). Champion (1965) found similar usnic acid sensitivity in an English woodcutter's wife who had only indirect contact with ash bark through her husband's working clothes. Since then he has seen patients with contact sensitivity to lichens who did not react to usnic acid. Several atopic patients had exacerbations of eczema as well as rhinitis and asthma after contact with lichens and algae, especially on apple trees. Three of them had positive patch tests with lichens (mainly *Lecanora* spp.), but algae gave only positive prick tests (Champion, 1971). Mitchell *et al.* (1969) now consider that in America as in Europe *Frullania* is a more frequent cause of dermatitis than lichens, and have studied cross-sensitivity between liverworts and Compositae (Mitchell *et al.*, 1970, 1972).

Cases of asthma caused by oak sawdust, with positive inhalation tests, were described by Scheven *et al.* (1963) and Sosman *et al.* (1969). The allergen was not identified and could have been either part of the wood itself or from *Frullania* on the bark. No satisfactory reports of asthma caused primarily by beech or chestnut sawdust have been found.

Three St John's patients gave positive patch tests with oak (209).

In Spain and Portugal workers with the bark of the cork oak (*Quercus suber* L.) suffer from suberosis, which starts with rhinitis, cough and dyspnoea and leads eventually to chronic bronchitic changes or extrinsic allergic alveolitis (Avila, 1972). The mechanism is unknown;

sensitivity to cork has not been demonstrated and fungus not found, but liverworts may not have been looked for. The cork contains much silica (Schepers, 1964; Cancelli, 1955, 1963).

English woodworkers in the High Wycombe area have a much higher incidence of adenocarcinoma in the paranasal sinuses than the general population (Acheson *et al.*, 1968). There is nothing to indicate which sawdust, if any, is responsible, but beech is the most largely used.

ULMACEAE

25. *Ulmus procera* Salisb. et spp.

English elm

Elm is one of the causes of 'woodcutter's eczema' (24). The leaves have irritant hairs on their under surfaces (Step, 1904; Genner & Bonnevie, 1938).

26. *Celtis briei* De Wild.

Diania

C. cinnamomea Ldl.

Gurenda

Diania is listed by Hublet *et al.* (1972) as irritating to skin or mucosae, without further details. Gurenda has an 'exceedingly unpleasant scent' (Gamble, 1902) and is used in medicine in Ceylon.

MORACEAE

27. *Ficus carica* L. et spp.

Fig, peepul

The sap of many species irritates and photosensitizes (Berlin, 1930; English & Grey, 1943; Behl & Captain, 1966). The aerial roots are used locally for timber.

28. *Piratinera guianensis* Aubl.

(*Brosimum guianense* Hub.)

Snakewood, amourette (NP),
letterwood, tigerwood,
muirapenima, muskatholz

Working with this wood causes headache, irritation of the nose and throat, nausea and skin inflammation (Grossmann, 1920). In Brazil, Freise (1932) found that the sawdust produced salivation and severe thirst, and all parts of the tree were very irritating to the skin where it was thin. Freise rubbed a little bark-powder on his forearm and there was burning inflammation leaving a stain which persisted for some weeks. Hausen (1970) found evidence of quinones in the wood.

29. *Brosimum paraense* Hub.

(*Piratinera paraensis* Ducke)

Satine, satiné rubané (NP),
muirapiranga, satinwood, bois de
Féroles, partridge wood

Hausen (1970) found that this wood contained quinones similar to those in amourette (28) and also much saponin, but the clinical evidence against it is less satisfactory. Czimatis & Hagemann (1910) listed as toxic (without any reference) bois de Féroles, which is now known to be *B. paraense* and not *Ferolia* sp. (Record & Hess, 1943). Freise's (1932) toxic 'muirapiranga' belonged to the Sapotaceae and was not *Brosimum*.

30. *Streblus brunoniana* F.Muell. Whalebone tree
(*Pseudomorus brononiana* Bur.)

The sap of this tough wood which is used by aborigines for boomerangs causes painful conjunctivitis (Maiden, 1920).

31. *Antiaris toxicaria* Lesch. Upas, ipoh

When gothic horror stories were in vogue at the end of the 18th century, travellers' tales exaggerated the powers of the deadly upas tree to such an extent that it was believed to devastate whole valleys, killing every animal in its shade and every bird that flew over it (Yule & Burnell, 1903; Oxford English Dictionary s.v. upas). Despite scientific scepticism the upas remained a symbol of venom until Malaya and Java became more familiar to Europeans through colonization and wars. The obsession with preternaturally toxic trees is still with us (Fleming, 1964).

The sap is in fact used as an arrow poison but it is harmless on unbroken skin (Gimlette, 1929). It contains a number of toxic glycosides including antiarin (Wehrli *et al.*, 1962).

Antiaris africana Engl.
A. welwitschii Engl.

Antiaris, ako (NP), oro, ogiovu,
kyenkyen, kirundu

Unlike the upas, these African species are exported commercially. Nigerian timber workers say their sawdust sometimes irritates the nose and skin (Woods, 1964), and they are careful not to let the latex touch scratches or skin eruptions (Irvine, 1961).

32. *Chlorophora excelsa* Benth. & Hook. f. Iroko (NP), mvule, odum, kambala,
C. regia A.Chev. moule, African teak

C. tinctoria (L.) Daub.

Fustic, mora, tatajuba (NP)

Czimatis & Hagemann (1910) reported two outbreaks of dermatitis in a waggon factory where men were sawing and planing moule. The symptoms were worse in hot weather when they were sweating more. A similar clinical picture with pronounced swelling and itching of the eyelids and genitals, sometimes accompanied by coughing and sneezing, was described by Loro (1923). Frei (1932a) obtained positive patch tests with sawdust, and Ragot & Brun (1948) with an aqueous extract. Davidson (1941) in Britain and Thienemann (1941) in Germany described further outbreaks. In East Africa unseasoned iroko caused dermatitis in men who could tolerate properly seasoned wood (Piorkowski, 1944).

King & Grundon (1949, 1950) isolated from the wood chlorophorin, an oxystilbene with unsaturated aliphatic side-chain (Fig. 4), and Schulz (1957, 1962) proved that this was the main sensitizer in his seven cases. Chlorophorin 1% in vaseline is useful in diagnostic patch tests (Wilkinson, 1971). Another stilbene, maclurin, used to be extracted on a large scale from *C. tinctoria* for use as a dye.

Irritation by this widely-used wood is still often reported in the trade (FPRL, 1963; Orsler, 1969) despite exhaust ventilation and other precautions. It is officially recognized in Belgium as a cause of industrial asthma (van Ganse, 1968). Two cases of iroko dermatitis have been seen at St John's (204).

- The mucilaginous sap of this locally-used wood causes dermatitis (Schur, 1932). It contains tetrahydroxystilbene, which is very similar to chlorophorin (32) (Laidlaw & Smith, 1959).

URTICACEAE

- Guaramo is used locally in Central and South America but not exported. Its sap and leaves cause dermatitis and it is an 'ant-tree', the hollow stems harbouring particularly vicious ants (Allen, 1943).

PROTEACEAE

- A native of Australia, but imported to the U.S.A. mainly from East Africa and called African silky oak there to distinguish it from *Cardwellia sublimis*.

May (1960) reported that a man developed erythema and bullae of the exposed skin and the genitals 2 days after sawing off a branch. A patch test with the sawdust gave a bullous response, but control subjects were not tested. Aborigines in Eastern Australia use the vesicant sap to scarify their bodies (Cleland, 1925). The flowers of *G. banksii* sensitize, but do not cross-react with those of *G. robusta* (Arnold, 1942). Several species contain 5-(10-pentadecenyl)resorcinol and other vesicant phenols very similar to those of poison ivy (Oocolowitz & Wright, 1962; Ritchie *et al.*, 1965; Ridley *et al.*, 1968).

SANTALACEAE

- No case reports of sandalwood dermatitis have been found. It is said to be toxic by Doerr (1913), Grossmann (1920), Hanslian & Kadlec (1966) and other authors, perhaps because the oil taken internally can produce eruptions. The oil has been found to irritate some animal skins experimentally (Opdyke, 1974). Not every so-called sandalwood or sandalwood oil comes from this species (Starke, 1967).

OPILIACEAE

- This satinwood substitute contains a saponin which irritates mucous membranes (Freise, 1932). The name pao marfim more often refers to *Aspidosperma Vargasii* (179), which is also irritant.

POLYGONACEAE

38. *Coccoloba uvifera* L. Sea grape
C. laurifolia Jacq. Pigeon plum

Twenty workmen in Strasbourg were said to have irritation of the eyes and nose after working with coccoloba in 1904. As investigations into the cause were unsuccessful nothing was published at the time, but Czimatis & Hagemann (1910) refer to the incident. Hausen (1970) who elucidated this, has also heard of irritation by the wood in Guadeloupe, but there are no published case-reports. Hausen found several alkaloids in the wood.

The strong sensitizer cocobolo (94) was not finally identified as *Dalbergia* spp. till 1918, and was long confused with similarly named woods such as *Coccoloba*, *Cocos* and *cocus* (Wiesner, 1903). Cocobolo seems the likeliest cause of the Strasbourg outbreak, as *Coccoloba* has never been much exported (Boulger, 1908; Record & Hess, 1943).

BERBERIDACEAE

39. *Berberis vulgaris* L. Barberry

The wood is used to a limited extent for turning and inlaying, and may cause cramps, vomiting and diarrhoea. It contains berberine and other alkaloids (Hausen, 1970).

MENISPERMACEAE

40. *Coccinium fenestratum* Coleor. Colomboholz, false calumba
 (*Menispermum fenestratum* Gaertn.)

The yellow wood contains up to 3.5% of berberine (39) (Perrins, 1852) and in Ceylon a dye and a bitter tonic are extracted from it. Vorreiter (1958) lists it as a toxic wood causing vomiting, diarrhoea and cramps, but the plant is only a climber and produces no timber (Gamble, 1902).

MAGNOLIACEAE

American whitewood

41. *Liriodendron tulipifera* L. Tulip tree, canary whitewood,
 poplar (U.S.)

Hausen (1970) described two cases of dermatitis of the hands and face from whitewood sawdust, one proved by patch tests, which were negative on ten eczematous controls. He found a labile quinone in the heartwood, but this did not appear to be the cause of the dermatitis. A sesquiterpene lactone has recently been discovered (Hausen, 1973). Nothing is known of the physiological activity of the isoquinolone alkaloid liriodenin, previously found in the wood.

MYRISTICACEAE

42. *Pycnanthus angolensis* Warb. Ilomba (NP)
Staudtia stipitata Warb. Niové (NP)

Hausen (1970) quoted trade reports that ilomba had caused nausea and vomiting, but he had no clinical details. Alemany-Vall (1958) lists niové as a skin-irritant.

LAURACEAE

43. *Phoebe porosa* Mez.
(*Ocotea porosa* L.Barr.)

Imbuya, imbuia (NP), embuia,
Brazilian walnut, laurel

Schmieg (1926) noted that imbuya sawdust was irritating to some workmen, and Schwartz (1931) reported eleven cases of vesicular dermatitis caused by it. The incidence varied from 10 to 20% in different factories, and many men without skin reactions had coryzal symptoms. Patch tests with moistened sawdust were positive on 'volunteers' (with dermatitis?).

Imbuya (Brazilian walnut) was identified as *Nectandra* sp. by Schwartz and earlier writers, but Record (1929) showed that it was in fact *Phoebe porosa*.

44. *Ocotea rodiaei* Mez.
(*Nectandra rodiaei* (Hook.) Schomb.)

Greenheart (NP), sipiroc,
Guyana-, Demerara-,
Antilles-greenheart

This very durable wood, exported for marine work since the eighteenth century, has sometimes been confused with the more irritating Surinam greenheart (*Tabebuia ipe* 190). Splinters of *O. rodiaei* cause troublesome wounds and the dust irritates workers' throats (Grossmann, 1920; Woods, 1951). It contains several alkaloids (McKennis *et al.*, 1956; Hearst *et al.*, 1968).

Ocotea barcellensis Mez.

Louro inamui, inhamui (NP),
jigue

O. rubra Mez.

Red louro, louro vermelho (NP),
determa, wana

O. puberula Nees.

Laurel amarillo

Many S. American species of *Ocotea* or *Nectandra* are called louro or laurel. Record & Mell (1924) describe the wood of *O. puberula* as peppery.

Five cases of dermatitis from louro have been seen at St John's (206).

Ocotea usambarensis Engl.
O. bullata E.Mey

East African camphorwood
Stinkwood, S. African teak

The FPRL (1963) have had two trade reports of skin and mucous membrane irritation by *O. usambarensis*. Schwartz *et al.* (1957) list *O. bullata* as a cause of dermatitis, but quote no source.

45. *Nectandra* spp. (many are called *Ocotea* spp. by
other botanists)

Freise (1932) divided the toxic Lauraceae of Brazil into three groups:

(a) Canella: *Nectandra* spp.

(b) Itauba: probably *Ocotea* spp., not *Mezilaurus* which is another itauba (Record & Mell, 1924).

(c) Pao cravo: *Dicypellium* (46)

According to Freise all these contain apiol and at least two alkaloids which cause vomiting, diarrhoea, cramps, cardiac stimulation, headaches and dizziness. Itauba also contains skatol.

Some *Nectandra* spp. from N. Brazil have a strongly irritant oil in their bark, which causes persistent pyoderma in the fingerwebs and at the angles of the mouth. See also 43.

46. *Dicypellium caryophyllatum* (Mart.) Nees Pao cravo, red wood, canella,
Cayenne rosewood

The bark of this tree is used as a substitute for cloves and cinnamon, but the wood is little exported from Brazil. Freise (1932) classes it with the toxic *Nectandra* and *Ocotea* spp. (45).

47. *Aniba rosaeodora* Ducke Bois de rose femelle (NP)
A. duckei Kosterm. Pau rosa

The *Convolvulus* rhizomes and stem-bases called rhodorhiza (186) were the main source of oil of rosewood in the nineteenth century, and when they were replaced by *Aniba* wood the old name lignum rhodii (or rhodium) was applied to both. Unlike rhodorhiza, *Aniba* had been used for cabinet work under the name of Jamaican rosewood, but oil extraction eventually proved more profitable (Record & Hess, 1943).

Grossmann (1910, 1920) said that men in his father's workshop could not work for long with 'rosewood' because of the headache, weakness, drowsiness, dyspnoea and dermatitis it caused. He was aware that rosewoods came from many different sources, but thought the ones responsible for these symptoms were *Convolvulus* and *Amyris* (105). As the *Convolvulus* rhizome was never used as timber (Boulger, 1908) he was probably referring to *Aniba* wood, the source of which was then uncertain (Record & Mell, 1924). However, he went on to say that the *Dalbergia* rosewoods were innocuous, which we now know to be wrong (see 94).

Grossmann's identifications are too shaky to support a case against *Aniba*, let alone *Convolvulus*. No other reports of toxic effects from either wood are known. Katz (1946) found in a series of patch tests on healthy subjects that rosewood oil caused at least one irritant reaction.

The wood contains linalool, anibine, cotoin and pinocembrine (Mors *et al.*, 1957; Gottlieb & Mors, 1958).

48. *Laurus nobilis* L. Laurel, bay
Cinnamomum camphora Nees & Eberm. Camphorwood
(*Laurus camphora* L.)

Dermatitis from oil of laurel (leaves) was reviewed by Fousereau *et al.* (1967), who showed that the allergen was an unsaturated ketone. It may be a sesquiterpene lactone, as cross-sensitivity with *Frullania* has been reported (Asakawa *et al.*, 1974). Camphorwood contains camphor and borneol, and Grossmann (1920) experienced severe headache and giddiness after working with it. A man with dermatitis from cassia flavouring gave a positive patch test with oil of cinnamon leaves (*C. zeylanicum*) and a stronger reaction with cinnamic aldehyde (Kern 1960).

Camphor wood is sometimes used for chests and cabinets; laurel wood hardly at all (Hinckley, 1960).

49. *Cryptocarya pleurosperma* White & Francis Poison walnut

Webb (1948b) described dermatitis starting on the hands 2 or 3 days after handling the cut bark or wood and later spreading to the face and the scrotum. He made no sawdust patch tests but

reproduced the symptoms with the blistering alkaloid cryptopleurine isolated from the wood by Lalande (1948). Poison walnut is used a good deal in Australia despite its known toxicity.

50. *Umbellularia californica* Nutt.

Oregon myrtle, bay, Californian olive

The bark and leaves contain a pungent volatile oil (Record & Hess, 1943). According to Chittenden (1931) it affects some people like poison ivy.

HERNANDIACEAE

51. *Hernandia sonora* L.

H. guianensis Aubl. et spp.

Toporite, topolite

Bois sabot (NP), mirobolan

Toporite was used in England for a time about 1950, but was found to cause dermatitis and has not been imported since (FPRL, 1963). It contains podophyllotoxin and picropodophyllin (King, 1953) (Fig. 7). Bois sabot is not exported from Central America.

CAPPARIDACEAE

52. *Crateva tapia* L.

Palo de guaco, garlic tree

The locally-used wood smells of garlic when first cut and its caustic sap produces a pronounced skin rash (Allen, 1943).

ALTINGIACEAE

53. *Liquidambar styraciflua* L.

American red gum, sweet gum, sap gum, hazel pine, bilsted, satin walnut, satinwood

Krais (1910) considered satin walnut irritant, but Legge (1907) and Grossmann (1920) were convinced that it was harmless and had been confused with irritant satinwoods such as *Fagara* (103). Nestler (1911) examined two specimens of 'East Indian satinwood' imported into Germany and found one was American satin walnut. An ether extract of the wood raised a painless blister on his arm, but the sawdust had no effect.

It is no longer much imported into Europe, but remains a major timber in the U.S.A. There are no reports of toxic effects there.

PLATANACEAE

54. *Platanus acerifolia* Willd.

P. orientalis L.

P. occidentalis L.

European plane, London plane
Oriental plane

American plane, buttonwood, sycamore (U.S.)

Plane is one of the trees that cause woodcutter's eczema (24). The down under the young leaves has been known since Galen's time to irritate the throat and eyes (Webster, 1920).

CHRYSOBALANACEAE

55. *Parinari guianense* Aubl. Guyana or Antilles satinwood,
(*P. variegata*, *Parinarium* spp., *Ferolia* spp.) atlaswood

The bois de Féroles from French Guyana, listed as *Ferolia* spp. by Czimatis & Hagemann (1910), was in fact *Brosimum paraense* Hub. (29) (Record & Hess, 1943). The toxic *Fagara flava* (103) used to be confused with *Ferolia* spp. (Grossmann, 1910).

There are no reports of toxic effects from wood properly identified as *Parinari*.

LEGUMINOSAE: MIMOSOIDEAE

56. *Albizia lebbek* (L.) Benth. **Kokko**, siris, acle, pluk,
(*Albizia lebbek*) E. Indian walnut, sneezewood
A. tetragona Willd. Mexican kieselholz, tendre à
(*Calliandra tetragona* Benth.) caillou
A. falcata Backer jeungjing, djeungdjing, batai
A. ferruginea Benth. et spp. **W. african albizzia**, ayinre, okuro

Many species of *Albizia* contain large quantities of saponin and are used as soaps and fish-poisons (Burkill, 1935). Those cut for timber produce nasal irritation and sometimes general malaise (Lewin, 1928; Vorreiter, 1958; Irvine, 1961). Griffioen (1949) described mucosal irritation from *A. falcata* in S. Africa, and the W. African species cause similar complaints (Wendorff, 1964; Farmer, 1972).

57. *Lysiloma latisiliqua* Benth. Sabicu (NP), jigüe,
(*L. l. sabicu*, *L. sabicu*) horseflesh mahogany

Peltophorum adnatum Gris. is also called Cuban sabicu or sabicu moruro. Legge (1907) quoted a Manchester factory inspector's report that 'sabicu wood from Cuba' gave off 'a snuffy dust under the machine and hand planes, the effect of which upon the worker is to cause a running at the eyes and nose, and a general feeling of cold in the head. The symptoms pass off in an hour or so after discontinuance of work'. See 58.

Virtanen & Gmelin (1959) found an alkaloid in *L. bahamensis* Benth.

58. *Pithecellobium arboreum* Urban Bahama sabicu, black tamarind,
(formerly *Pithecolobium*) turkey gill

Bahama sabicu was used from 1878 for bobbins in English cotton-mills (Record & Mell, 1924) and is another possible source of the sabicu mentioned above (57). Freise (1932) identified his irritant wood angelim (partridge wood) as *Pithecolobium* sp. but this seems improbable (Record & Hess, 1943). Schwartz *et al.* (1957) quote no source for their listing of *P. arboreum* and *P. filicifolium*.

59. *Samanea dinklagei* Keay

The pounded bark is a soap substitute, and the dry sawdust irritates the nose and throat (Irvine, 1961). The timber is not exported from W. Africa.

60. *Acacia melanoxylon* R.Br.
A. harpophylla F.Muell.
A. shirleyi Maiden

Australian blackwood

Brigalow
 Lancewood

Workers in joinery shops and motor-body factories sometimes developed severe itching, weeping dermatitis on the forearms, neck and face after using Australian blackwood (Cleland, 1925). Cleland found that patch tests on himself were negative and suggested that sensitization must play a part. Nott (1925) had a papular rash on his own hands and forearms after working with blackwood.

'Brigalow itch' affects men ringing the trees and is probably due to a fine yellow powder on the bark, but irritant bag-moth shelters and cocoons are found on several related species (Cleland, 1925). Splinter wounds from *A. shirleyi* and other species are often troublesome and persistent (Maiden, 1919; Webb, 1948a).

Acacia wood contains flavonols, stigmaterol, saponins, etc. but the irritant has not been identified (Hausen, 1970).

61. *Prosopis juliflora* (Sw.) D.C.

Mesquite, mezquit

Stewart (1940) reported a case of dermatitis of the face in a man working on a cabinet made of mesquite, and obtained a positive patch test with the sawdust. Fox (1941) described extensive dermatitis in a farmer who regularly sawed up the wood for a stove, and found patch tests with the moist sawdust and an ether extract were positive. The wood is used only locally in the southern U.S.A. and Central America. Hausen (1970) found evidence of an alkaloid in it (not prosopinine, an irritant alkaloid found in the leaves and perhaps the wood of *P. africana*).

62. *Piptadeniastrum africanum* Brenan
 (*Piptadenia africana* Hook. f.)

Dahoma, ekhimi, agboin,
 dabéma (NP), mpewere

Freshly sawn wood has a strong ammoniacal smell, which disappears on seasoning. Irritation of the eyes and nose by its sawdust is well known to timber workers in Africa (Irvine, 1961; Wendorff, 1964) and elsewhere (Anon., 1923; Nomenclature générale, 1965), but skin irritation is less common (FPRL, 1963; Farmer, 1972). All the thirteen men working with dahoma in one English factory complained of severe irritation of the nose, throat and trachea (MacKenna & Horner, 1954).

63. *Xylia xylocarpa* Taub.
 (*X. dolabriiformis* Benth.)

Pyinkado (NP)

The sawdust causes sneezing (Laslett, 1894; Boulger, 1908).

64. *Plathymenia reticulata* Benth.
Echiospermum balthazarii Fr.All.

Vinhatico, v. castanho,
 v. espinho

The sawdust of vinhatico contains saponins which are very irritating to the nose, conjunctiva and other mucous membranes (Freise, 1932). Freise identified it as *E. balthazarii*, but according to Record & Mell (1924) *P. reticulata* is the more likely source in Brazil. Yet another vinhatico is *Chloroleucon vinhatico* Record, from Honduras (Nomenclature générale, 1965).

LEGUMINOSAE: CAESALPINIOIDEAE

65. *Erythrophleum guineense* G.Don. **Missanda**, tali (NP), sasswood,
E. ivorense A.Chev. erun, red-water tree
- The bark of sasswood contains several alkaloids with digitalis-like action and has long been used in W. Africa for judicial ordeals and as a fish-poison. Men preparing the bark suffer from coryzal symptoms (Cornevin, 1887; Irvine, 1961). Lewin (1928) said that an extract of the wood caused vomiting, respiratory disturbance, bradycardia, headache and vertigo, and anaesthetized mucous membranes by contact, but Hausen (1970) found alkaloids only in the bark and not in the wood. The FPRL (1963) receives a number of trade complaints about irritation of the nose and eyes by the wood, and troublesome splinter wounds.
- E. labouchei* F.v.M. in Australia and *E. coumiga* H.Bn. in Madagascar are probably also toxic (Hausen, 1970; Golse, 1937).
66. *Copaifera bracteata* Benth. **Copaiba**
- This was formerly thought to be the source of the wood called purpleheart or amarant (Stone, 1924; Gayer, 1928), toxic effects from which were described by Grossmann (1920). Purpleheart is now known (Record & Hess, 1943; Nomenclature générale, 1965) to come from *Peltogyne* spp. (68). *C. bracteata* produces no significant timber but only copaiba gum.
67. *Hymenaea courbaril* L. et spp. **Courbaril** (NP), copalier,
 algarrob, W. Indian locust
- The wood causes skin irritation (Freise, 1932). Copal resin is obtained from this tree.
68. *Peltogyne densiflora* Spruce **Purpleheart**, amarante (NP), pau
 et spp. roxo, bois violet, blue wood
- Purpleheart, formerly thought to come from *Copaifera* (66), has a very unpleasant smell when worked and causes nausea and loss of appetite (Grossmann, 1920). The dust from working and polishing it causes cough and sometimes nettlerash in Brazil (Freise, 1932). De Sousa *et al.* (1967) found the known allergen 4-methoxydalbergione (94) in the heartwood of *P. densiflora* and of *Goniorrhachis marginata* Taub. (guarabu, itapicuru). No toxic effects have been reported from guarabu.
69. *Afzelia africana* Smith et spp. **Afzelia**, doussié (NP), apa,
 aligna, chanfuta, lingue
- In West Africa there are frequent complaints of skin and nasal irritation from afzelia (Irvine, 1961; Woods, 1964), and after an early trial at the Imperial Institute in London it was reported to be 'very unpleasant to work owing to its dust causing sneezing' (Anon, 1923). Trade complaints are not common now in England, however (Orsler, 1969), though they occur in France (Raymond, 1959). *Afzelia* contains kaempferol and other catechins (King & Acheson, 1950; King *et al.*, 1955).
70. *Distemonanthus benthamianus* Baill. **Ayan**, movingui (NP), anyaran,
 Nigerian satinwood
- Morgan & Thomson (1967) reported the case of a man who had several attacks of dermatitis

after exposure to shavings and sawdust of ayan. Patch tests were positive with sawdust and with oxyayanin A and B extracted from it, but hardly at all with its other flavonoids ayanin and distemonanthin (isolated by King *et al.*, 1954). Some specimens of ayan contain more oxyayanin B, some more distemonanthin, and there are corresponding variations in their sensitizing capacity. Oxyayanin A has recently been found also in *Apuleia leiocarpa* (71).

Thirteen cases of ayan dermatitis have been seen at St John's (199).

71. *Apuleia molaris* Spruce
(*A. leiocarpa* MacBride, *A. ferrea* Mart.)
- Ferro (NP), muirataua,
redwood, garapa

Some botanists (but not Record & Hess, 1943) separate *A. molaris* (muirataua) from the more widespread *A. leiocarpa* (garapa).

The toxic action of this wood persists for years after it is dry, and workers once affected usually become hypersensitive to it (Freise, 1932). A German carpenter developed headache, vertigo, visual disturbances, thirst and dyspnoea after contact with the fresh sawdust, especially on hot days (Freise, 1936). He later had increasingly severe dermatitis on the hands and arms. Freise found in the wood the cytosine-like alkaloid phellandrene, a saponin, and two red dyes which seemed to be responsible for the dermatitis. More recent workers have identified flavonoids including the known allergen oxyayanin A (Braz Filho & Gottlieb, 1968)—see 70.

The nomenclature of S. American timbers is always obscure, but Freise (1936) has muddled the waters very thoroughly here. He heads the section on *A. molaris* 'Cocoboloholz' but later explains that it is not cocobolo but a substitute for it; then he calls it the 'Caesalpiniaceae apuleia molaris Benth', which has misled some later authors into placing it in a non-existent genus *Caesalpiniaceae*.

72. *Cassia siamea* Lamk.
- Djoher (NP), muong ten,
tagayasan, bois perdrix

Iwakawa (1911) studied the conjunctivitis, keratitis and iritis, sometimes accompanied by dermatitis with brown staining of the skin, which affected Japanese furniture workers using this wood. Cracks in the wood contain a yellow powder darkening to violet on exposure, in which he found the irritant anthranol of chrysophanic acid (see 97).

73. *Koompassia excelsa* Taub.
- Kempas** (NP), tualang

The sap is said in Malaya to irritate the skin, producing an inflammation like erysipelas (Burkill, 1935). Titmuss (1965) comments on the pungent smell of the wood when fresh.

74. *Dicorynia guianensis* Amsh.
(*D. paraensis* Benth.)
- Basralocus** (NP), angélique

This teredo-resistant wood contains much silica and two alkaloids, one of which is tryptamine (Sander mann & Lange, 1967). There is no clinical evidence against it, however, except a casual remark by Baumer (1955) that it is 'reputed toxic'.

75. *Haematoxylum campechianum* L. Logwood, campeche
 The dye haematoxylin used to be extracted on a large scale from logwood. Hausen (1970) quotes an unconvincing case of dermatitis from the sawdust in 1912 (without patch tests), and Sézary & Deval (1932) described dermatitis of the hands said to be due to haematoxylin dye in gloves. Patch tests were positive with the glove but not done with the dye.
76. *Caesalpinia echinata* Lam. **Brazilwood**, pernambouc (NP),
 (*Guilandina echinata* Spreng.) fernambouc, Bahia wood, para
 wood, pau Brasil, ibiripitanga
C. paraensis Ducke Muirapixuna
 According to Record & Hess (1943), muirapixuna is *Swartzia tomentosa* DC.
 Freise (1932) includes these among the Leguminosae that cause skin irritation. The nomenclature is very confused.
77. *Microberlinia brazzavillensis* A.Chev. **Zebrano**, zingana (NP), amouk,
M. bisulcata A.Chev. African zebrawood
 Zafiropoulo *et al.* (1968) list this wood as irritant but quote no source. *Astronium* spp. (137) and other known irritant woods are also called zebrawood.
78. *Batesia floribunda* Benth. Acapú rana (NP)
Campsiandra laurifolia Benth.
 Both these woods are called acapú rana (false acapú) or manaiara according to Freise (1932), who says that men using mechanical saws on them suffer from headaches and sometimes vomiting.
79. *Melanoxylon brauna* Schott Braúna (NP), grauna
 Freise (1932) describes pustules and necrotizing inflammation caused by the sawdust of braúna, especially when it contaminates minor wounds on the legs. The seedpods contain an alkaloid with cardiac and respiratory effects.
80. *Zollernia paraensis* Hub. et spp. Pau santo (NP), mocitahyba
 Freise (1932) names pau santo as one of the Leguminosae that cause irritating swellings of the skin.

LEGUMINOSAE: PAPILIONOIDEAE

81. *Castanospermum australe* A.Cunn. **Black bean**, Australian or
 Moreton Bay chestnut
 Black bean has been 'accused of injuriously affecting the health of workmen' in Australia, where it is used for high-class joinery (Maiden, 1909). It contains saponins, a phenol, and flavonoids including afrormosin (Eade *et al.*, 1963). Greshoff (1909) blamed saponins for the irritating effect of its sawdust on mucous membranes.

82. *Bowdichia nitida* Benth. et spp.*Diploporis purpurea* Amsh. et spp.(*D. guianensis* Benth., *B. guianensis* Ducke)Yellow sucupira is *Ferreira spectabilis* (87).**Sucupira**, coeur dehors (NP),

black sucupira, zwarte kabbes

Sucupira, s. assu, sapupira, coeur
dehors (NP)

Freise (1932) included sucupira among the irritant Leguminosae. Heyl (1966) reported the case of a joiner who developed dermatitis on the fingers, eyelids, elbow flexures and dorsa of the feet (working in sandals) whenever he used sucupira or palisander (*Dalbergia nigra*). Patch tests with both woods were strongly positive, and negative on nine controls. Hausen (1970, 1972) found that Heyl's sucupira was *B. nitida* and isolated three labile quinones from it, but could identify only the least active (2,6 dimethoxy-p-benzoquinone). The patient gave positive patch tests with all three, and also with dalbergiones.

83. *Pericopsis elata* van Meeuwen(*Afrormosia elata* Harms.)**Afrormosia**, kokrodua (NP),

asamala, obang, oleo pardo

The FPRL (1963) receives occasional trade reports of skin and respiratory irritation (Orsler, 1969), and it is listed by Gronemeyer & Fuchs (1967) as a cause of asthma. Splinter wounds from afrormosia are said to be troublesome and often become septic (Wilkinson, 1971). In Germany there are trade reports of cramps and paralytic symptoms which may be due to the N-methylcytisine it contains (Hausen, 1970).

Two St John's patients gave positive patch tests with afrormosia (197).

84. *Myroxylon balsamum* Harms.

Balsamo (NP), quina-quina,

oleo vermelho, cabreuva

vermelha

There are two varieties: *balsamum* (*M. toluiferum* H.B.K.) which yields balsam of Tolu, and *pereirae* (*M. peruiferum* L.f.) giving balsam of Peru. Dermatitis from balsam of Peru (Opdyke, 1974) was investigated by Hjorth (1961), but there are no reports of reactions to the timber. It probably comes more from the *balsamum* variety (Record & Mell, 1924).

85. *Sophora japonica* L.*S. tetraptera* J.Mill.

Pagoda tree, yen-ju

Kowhai

The bark of the pagoda tree has a strong smell which affects those who prune it. Four turners had colic and diarrhoea after working with freshly cut wood, but the dry wood is said to be harmless (Du Hamel, 1811; Loudon, 1844). It is little used outside China and Japan. Two people were seriously ill after eating from spoons made of kowhai wood (Aston, 1923). The seeds of *Sophora* spp. contain cytisine and related alkaloids (Briggs, 1946).

86. *Baphia nitida* Afzel.**Camwood**

The sawdust is very pungent, like snuff (Holtzapffel & Royle, 1843). A red dye used to be extracted from the wood, but it is hardly used as timber. The related nyala wood (*Xanthocercis*, formerly *Pseudocadia zambesiaca* Harms.) is also a strong mucosal irritant (Codd, 1951).

- 87.
- Ferreirea spectabilis*
- Fr.All.

Lapachin (NP), manisito,
yellow sucupira

King *et al.* (1952) found chrysophanic acid anthranol in this little-exported S. American timber, but Simatupang *et al.* (1967) could not confirm this. They suggested that King's material came from *Vatairea hundertlii* (98), which is microscopically similar.

- 88.
- Laburnum anagyroides*
- Medic.

Laburnum*(L. vulgare* Gris., *Cytisus laburnum* L.)

The wood of laburnum, like the notoriously poisonous seeds, contains the alkaloid cytisine (Cornevin, 1887). According to Lewin (1928) the sawdust causes salivation, sore throat, vomiting, headache and muscle pains, oliguria and faintness, but he quotes no cases or references.

- 89.
- Robinia pseudoacacia*
- L.

Robinia, acacia, false acacia,
black locust

Acacia is one of the trees that cause woodcutter's eczema (24) in France (Schulmann & Détouillon, 1932). Wood (1957) mentions 'the strong dislike of the woodman for its fearsome thorns'.

- 90.
- Millettia laurentii*
- De Willd.

Wenge (NP)*M. stuhlmannii* Taub.**Panga-panga**

Splinters of wenge lead to persistent wounds, and the sawdust causes abdominal cramps. Hausen (1970) found a quinone (perhaps a mixture) in the wood but could not sensitize guinea-pigs with it, or persuade the splinter patients to submit to patch tests. Hublet *et al.* (1972) list wenge among timbers causing mucosal or cutaneous irritation in Belgium but give no details.

- 91.
- Brya ebenus*
- DC.

Cocuswood (NP), cocus, grana-
dillo, brown ebony, green e.,
Jamaican e.*(Amerimnum ebenus* Sw., *Inga vera* Willd.)

During the nineteenth century cocuswood replaced boxwood as the favourite wood for flutes, though it was known to cause irritation of the lip in some players (Rockstro, 1890). Stern (1891) reported a case of persistent dermatitis of the lip and chin from a flute made of grenadilla or red ebony, which was almost certainly Cuban cocuswood. No patch tests were made, but the dermatitis cleared up as soon as the player changed to an ivory mouthpiece. Crocker (1903) mentioned dermatitis in flute-makers sawing up cocus wood. Thompson (1914) described dermatitis of the face due to 'cokus', which he distinguished clearly from 'coca-bola' (94). Some authors have confused cocus not only with cocobolo but even with the completely unrelated coconut palm (*Cocos*).

Schröpl (1935) described an unconvincing case of dermatitis in an instrument-maker who had not been in direct contact with cocus wood but gave a positive patch test with it.

Hausen (1970) found at least three quinones in the heartwood but could not identify the sensitizer.

92. *Piscidia erythrina* L. Jamaica dogwood
The wood is a fish-poison, and according to Lewin (1962) also toxic to humans. It is little used as timber and no reports of ill-effects have been found.
93. *Pterocarpus indicus* Willd. **Amboyna**, padauk (NP), padouk, New Guinea rosewood, narra, bija
P. santalinus L.f. Red sandalwood, padauk (NP), santal rouge, red sanders
P. angolensis D.C. **Muningga** (NP), kejaat, kiaat, African padauk, mbila, girassonde

Nestler (1924, 1926) quoted a statement in a German trade journal of 1910 that padouk wood from the Sunda islands (Indonesia) caused painful swelling and redness of the face in men working with it. He obtained two different specimens called padouk wood, neither of which could be identified botanically, though one resembled *P. indicus*. Ether extraction of this wood produced a red essential oil which caused irritation of his skin in less than 2 h, but the sawdusts of both woods and all other extracts of them gave negative patch tests.

Two Hamburg sawmill workers complained of an unpleasant sweet taste in the mouth, repeated vomiting and conjunctival irritation after contact with Ceylon mahogany, thought to be *P. santalinus* (Hausen, 1970). Other woods, such as *Artocarpus integrifolia* L., have also been called Ceylon mahogany (Boulger, 1908).

Ordman (1949) described two cases of asthma in men working with *P. angolensis*, one of whom was also sensitive to *Thuja plicata* (13) and a Congo hardwood identified by Schweisheimer (1952) as *Lovoa klaineana*. Intradermal tests with an aqueous extract of kejaat were positive.

Pterocarpus spp. contain pterostilbene and other fungicidal substances (Fig. 4), but these have not been shown to be toxic to man (Bevan, 1958).

94. *Dalbergia retusa* Hemsl. **Cocobolo** (NP), granadillo, *D. granadillo* Pitt. nambar, palo negro, foseholz, (Amerimnon *granadillo* Standl.) red foxwood, rosewood
D. hypoleuca et spp.

Nestler (1912) investigated a sample of cocobolo which had been sent to him because it caused dermatitis in workers. He obtained strongly positive patch tests on himself and other subjects with moist sawdust, and with alcohol and benzol extracts. Mackee (1913) described in detail dermatitis of the hands and face in men sandpapering cocobolo hairbrushes. Its irritant properties were already well known in the trade.

At that time there was much uncertainty about the origin of cocobolo, which was confused with *Coccoloba* (38), *cocus* (91) and other woods, but Pittier established in 1918 that it came from the above Central American *Dalbergia* species (Record & Hess, 1943). Record & Garratt (1923) wrote a monograph on cocobolo, clarifying its botany and quoting accounts of dermatitis from many American firms. The incidence was from 10 to 30%. The eruption began on the face and hands, and in severe cases became generalized with conjunctivitis and sometimes headache. Only men exposed to the fine dust from sawing, boring or sanding were affected, and then mainly in hot weather. Extractors were helpful but did not completely prevent trouble.

Cases of localized dermatitis from contact with knife-handles, bracelets, recorders, and other

finished articles made of cocobolo were reported by Levin (1941), Leider & Schwartzfeld (1950), and Howell & Blair (1950). Many recorders were made of cocobolo in Germany about 1930, but they caused dermatitis of the mouth so often that the use of the wood had to be abandoned (Anon., 1933; Steinbrinck, 1950; Hausen, 1970). Meister (1934) described two cases of severe swelling of the eyelids with conjunctivitis, brought on by playing cocobolo recorders. The lips were not affected, though he had heard of a third case confined to the mouth. No patch tests were made.

Eaton (1973) reported two cases of nasal irritation in workers finishing and sanding cocobolo, with positive prick and patch tests (but no controls). One also had asthmatic symptoms. Some improvement was claimed after desensitizing injections. A third case was not definitely connected with cocobolo.

D. retusa contains S-4'-hydroxy-4-methoxy dalbergione, R-4-methoxy dalbergione and other quinones and phenols (Schulz & Dietrichs, 1962; Hausen, 1970).

Dalbergia nigra Fr.All.

D. cubilquitzensis Pitt.

D. spruceana Benth.

Brazilian rosewood, jacaranda,

palissandre Brésil (NP),

Rio or Bahia rosewood, caviuna,

palisander, jacaranda pardo

Gougerot & Blamoutier (1922b) described eczema of the face and hands in a cabinet-maker working with palissandre, the source of which was not stated. Patch tests were positive with palissandre dust and an alcoholic extract of it, and negative with walnut and mahogany which he was also using. Application of increasing amounts of the extract to the patient's skin over a period of 11 days was said to produce successful desensitization. Gougerot & Delay (1932) reported another case of palissandre dermatitis, associated with lacrimation, sneezing and coughing. Touraine *et al.* (1934) identified the 'palissandre des Indes' in their case as *D. nigra*, but their botanical remarks are not impressive and its origin suggests *D. latifolia* (see below). Tottie (1938) described three cases of dermatitis in carpenters using Jacaranda envaco, which is a Brazilian name for *D. nigra*, not to be confused with the unrelated botanical genus *Jacaranda*.

In Brazil itself Freise (1932) described dermatitis in forestry workers handling various kinds of jacaranda, and Barroso (1947) wrote about dermatitis from caviuna, identified as *D. nigra*. He extracted a resin from the sawdust which gave positive patch tests on the patient, and sensitized rabbits and guinea pigs with it experimentally. Gronemeyer & Fuchs (1957) list *D. nigra* among the timbers which cause asthma. It contains R-4-methoxy-dalbergione and other quinones (Schulz & Dietrichs, 1962).

D. nigra is now in short supply, and the more irritant *Machaerium scleroxylon* (95) is sometimes substituted for it (Eyton *et al.*, 1965).

Dalbergia latifolia Roxb.

D. sissoo Roxb.

D. oliveri Gamb.

D. greveana Baill.

D. cochinchinensis Pierre

Indian rosewood, E. Indian r.,

Bombay blackwood

Sissoo, shisham

Burma tulip wood, pinkwood,

bois de rose

Madagascar rosewood, French r.

Thailand rosewood, chin chan

The international name for all these (and more) species from Asia and Madagascar is Palissandre Asie (NP).

Sternberg (1908) described the urticarial rashes and swellings he had seen some years earlier in carpenters working with Indian rosewood. Escartefigue's (1935) patient developed dermatitis under a necklace and bracelet of Madagascar palissandre, but he made no patch tests. Some of the French cases mentioned under *D. nigra* may have been due to Asian palisanders. Findley (1972) reported disabling dermatitis in a man who had only indirect contact with *D. latifolia* sawdust.

D. latifolia and *D. cochinchinensis* contain R-4-methoxy dalbergione and other quinones (Dempsey & Donnelly, 1963; Donnelly *et al.*, 1968). Some related species which do not provide timber are used as fish-poisons (Lewin, 1928).

Dalbergia stevensonii Standl.

Honduras rosewood, nagaed
wood, palissandre Honduras
(NP)

Three trade reports of dermatitis from this wood (used particularly for xylophones) were known to the FPRL (1963). It contains 4-methoxy dalbergione (Hausen, 1970).

Dalbergia melanoxylon Guill. & Perr.

African blackwood (NP),
mpingo, Mozambique or Senegal
ebony, ébène, African grenadilla

Clarinets are usually made of African blackwood in England, and it is often used for flutes and other instruments, especially in Germany. Moll (1950) mentioned that it was known in the trade to be irritant. Two cases of dermatitis in clarinet-makers have been seen at St John's (201).

D. melanoxylon contains several quinones including S-4'-hydroxy-4-methoxy dalbergione (Donnelly *et al.*, 1969), and S-4-methoxy dalbergione (Hausen, 1970) which is also found in *D. violacea* (Eyton *et al.*, 1965).

Dalbergia variabilis Vog.
D. oliveri Gamb. et spp.

Brazilian tulipwood,
bois de rose (NP)

D. cearensis Ducke

Kingwood bois de violette (NP),
violet wood, violetta

There are no reports of toxic effects from tulipwood, which was formerly thought to belong to *Physocalymma* (Lythraceae).

D. cearensis is probably the 'kingwood' which Freise (1932) called *Machaerium violaceum* Ducke (Record & Hess, 1943). He described it as a very severe skin-irritant, often leading to persistent ulceration.

Chemistry of Dalbergia spp.

Earlier workers, summarized by Sandermann & Barghoorn (1956), blamed flavones, saponins and glycosides for the irritant effects of rosewood, but the discovery of sensitizing quinones in other woods such as teak and mansonie led Schulz & Dietrichs (1962) to look for similar substances in *D. nigra* and *D. retusa*. They found three quinones which they called Dalbergia-quinones A, B and C, and demonstrated by patch tests on patients that these were the sensitizers,

the strongest being R-3,4-dimethoxydalbergione. Eyton *et al.* (1965) have studied the chemistry of this 'neoflavanoid' group of quinones in detail (Fig. 3). They have now been found in other *Dalbergia* spp., *Machaerium* (95), *Peltogyne* (68) and *Goniorrhachis* (68) (Hausen, 1970).

Ten patients sensitive to rosewood from *Dalbergia* spp. have been seen at St John's (201, 213).

95. *Machaerium scleroxylon* Tul.

Caviuna vermelha, caviuna,
jacaranda caviuna, pao ferro

Occasional logs of this inferior and more irritant substitute have always found their way into shipments of Brazilian rosewood (Record, 1926), but with the current popularity of rosewood and increasing scarcity of *D. nigra* the proportion is likely to increase (Phillips, 1966; Farmer, 1972). Morgan *et al.* (1968) described an outbreak of dermatitis in a furniture factory where it was unwittingly substituted for *D. nigra*. Seven of the twenty-four men exposed developed dermatitis on the hands, face and neck. Patch tests produced very strong reactions to *M. scleroxylon* sawdust with milder reactions to *D. nigra*, and the sensitizers were shown to be R-3,4-dimethoxy dalbergione and its related quinol (Fig. 3). Cases have also been reported in Brazil (de Miranda Bastos & de Matos Filho, 1960) and in Hamburg (Hausen, 1970), where patch tests were positive with the sawdust and with R-3,4-dimethoxy dalbergione.

Machaerium violaceum Vog.
Paramachaerium schomburgkii Ducke
(*Machaerium schomburgkii* Benth.)

Orelha d'onça, kingswood (?)
Jacaranda, ximbo

The status of these woods as irritants is doubtful. Freise (1932) listed *M. violaceum* Ducke, but his name orelha d'onça is not found elsewhere and the usual source of 'kingswood' is *Dalbergia cearensis* (94). *M. violaceum* was, however, regarded as one source of Brazilian rosewood at that time (Howard, 1934).

M. schomburgkii seems to have been taken by Hanslian & Kadlec (1966) from Grossmann (1910), but he only mentioned it as one of the less likely sources of snakewood, which is now certainly known to be *Piratinera guianensis* (28).

96. *Andira inermis* H.B.K.

A. coriacea Pulle

Angelin (NP), angelim, kuraru,
partridge wood, cochenilla
Saint Martin rouge (NP), angelin,
red cabbage tree, mocha
colorado

Lewin (1928) said that angelim was a skin-irritant. Freise (1932) described persistent cough and urticarial eruptions in those working with angelim (partridge wood), which he identified improbably as *Pithecolobium* sp. Ducke. The bark and seeds contain a poisonous alkaloid (Allen, 1943) and the wood contains demethylpterocarpin, which is an isoflavanoid similar to the strongly allergenic dalbergiones, and biochanin A which is related to ayanin (70) (Cocker *et al.*, 1962).

Simatupang *et al.* (1967) examined the very similar *A. coriacea* for irritant anthranols but found none (see 98).

97. *Vataireopsis araroba* Ducke
(*Andira araroba* Aguiar)

Angelim amarello, a. amargoso,
a. araroba, faveira, araroba

The sawdust irritates the eyes of workmen (Record & Hess, 1943). Goa powder, found in the bark and wood, is the source of chrysarobin, the active principle of which is chrysophanic acid anthranol (Simatupang *et al.*, 1967). Before the introduction of dithranol it was a standard treatment for psoriasis (Trousseau, 1886; Pautrier, 1904). The timber is not exported.

98. *Vatairea guianensis* Aubl.

Quassia wood, gele kabbes,
partridge wood

This wood caused several cases of dermatitis and conjunctivitis when it was imported into Hamburg incognito among other S. American timbers (Simatupang *et al.*, 1967). It was found to contain chrysophanic acid and physcion, and their anthranols which are the irritants as in chrysarobin. *V. lundellii* contains only chrysophanic acid (see 87).

99. *Coumarouna odorata* Aubl.
(*Dipteryx odorata* Willd.)

Tonka (NP), cumarú, tonquin bean

'On being sawed into thin slabs it gave off a most unusual quantity of bright red sawdust which covered the workmen. One of them, thinking to wash the dust from his hair, dipped his hair into a bucket of water, when, to his surprise, the hair turned a bright grass-green colour. It took him several days of scrubbing to restore the natural colour' (Thompson, 1914). In a brief trade journal report (Anon, 1906) twenty-six men in a Cambridge (Mass.) furniture factory were said to have been 'poisoned' by handling tonquin wood from the Philippines.

Coumarin is obtained commercially from tonquin beans and probably also occurs in the wood, which sometimes smells of vanilla (Record & Hess, 1943).

100. *Vouacapoua americana* Aubl. et spp.
(*Andira excelsa* H.B.K.)

Wacapou (NP), acapú, tatbu,
sapupira, partridge wood

Freise (1932) describes acapú as causing persistent itching papules. Cocobolo is not this wood (as Freise suggested) but *Dalbergia* spp. (94).

101. *Gossweilerodendron balsamiferum* Harms.

Agba, tola (NP), tola branca,
Nigerian cedar

A few cases of skin irritation have been reported to the FPRL (1963) (Orsler, 1969), and two have been seen at St John's (198). The wood is extensively used, however, and the incidence of reactions probably low. Symanski (1957) mentions asthma caused by the sawdust of 'tola', which was probably agba rather than the less common tchitola (*Oxystigma oxyphyllum* Léon.)

ZYGOPHYLLACEAE

102. *Guaiacum officinale* L. et spp.

Lignum vitae, gaiac (NP),
guayacan, pockholz

The sawdust causes sneezing, especially that of *G. arboreum* D.C., which a French workman

called *pique-nez* (Guibourt, 1849). The FPRL (1963) had two trade reports of mucosal irritation. Frei (1932b) described a case of dermatitis which began round a minor finger wound contaminated with lignum vitae sawdust, and spread to the hands and arms. Patch tests were positive with lignum vitae and negative with mahogany, walnut, palisander and teak. Control subjects gave negative patch tests.

RUTACEAE

103. *Fagara flava* Krug. & Urb.
(*Zanthoxylum flavum* Vahl.)

West Indian satinwood,
Jamaican or San Domingan
satinwood, espenille (NP),
yellow sanders, atlaswood,
citronwood, zitronenholz

Botanists have still not agreed whether to place this species in *Fagara* or *Zanthoxylum*, but seem determined to keep the curiously illiterate spelling of the latter in preference to *Xanthoxylum* which was once commoner. Several other species of these and related New World genera provide satinwoods of poorer quality, some of which have been described as toxic (Smith, 1920; Lewin, 1928). See 104 below. Many of the vernacular names given above are highly non-specific.

Grabham (1905) wrote that dermatitis from satinwood (mainly *F. flava*) was well known among labourers in the West Indies; he had had it himself. Wechselmann (1909) gave a clear description of dermatitis in a joiner using *F. flava*, with a positive patch test with the sawdust of this wood only, and suggested an 'anaphylactic' mechanism. Sieghem (1909) and Volk (1911) investigated three more cases of satinwood dermatitis in which the identification of the wood was less satisfactory and the patch tests equivocal. There are many other reports of dermatitis from satinwood, atlaswood, citronwood or zitronenholz, which may or may not have been *Fagara* spp. (Brezina, 1913; Oppenheim, 1909; Noll, 1931). *F. caribaea* is one of a number of woods called zebrawood (137) and not the only one likely to cause dermatitis. See also 108.

Fagara macrophylla Engl.

African satinwood, olonvogo
(NP), olon dur, bahé, bongo,
lisumba

F. heitzii Aubrev. & Pellegr.

Olon (NP), bongo, mbanza

F. inaequalis Engl.

Pillon & Martinez (1935) reported an outbreak of severe dermatitis and coryza affecting all the eight men present when a very dry trunk of olon was sawn up producing much fine dust. A damper section of the same trunk was sawn elsewhere without any trouble. Rochaix & Vieux (1936) tried to sensitize rabbits experimentally with olon sawdust, but could demonstrate only a primary irritant effect. The bark is vesicant and is used in arrow poisons (Irvine, 1961). The FPRL (1964) has received a few reports of irritation from olon in England, and Hausen (1970) mentions a trade report of skin irritation by olonvogo in Hamburg.

The early work on the chemistry of *Fagara* spp. reflected the contemporary bias towards alkaloids. Wechselmann (1909) found chloroxylonine (see 108) in *F. flava* and obtained positive patch tests with it on his patient and himself, but not on two other people. Auld & Pickles (1912) found only pungent resins, while Freise (1937) found xanthotoxin and an alkaloid. More recent

work has demonstrated suberosin and other coumarins, psoralene and xanthotoxin in *Fagara* and xanthyletin in *Chloroxylon* (King *et al.*, 1954).

Wilkinson (1971) has seen a case of clinical photosensitivity to *Chloroxylon swietenia* (108) but this could not be confirmed experimentally. Photosensitization is characteristic of the Rutaceae (Woods, 1962), and if it does prove to be the mechanism of timber dermatitis in this family many of the inconsistencies in the earlier literature would be explained.

104. *Euxylophora paraensis* Hub.

Esenbeckia leiocarpa Engl.

Raputia magnifica Engl.

R. alba Nees & Mart

Balfourodendron riedelianum Engl.

Amarelo (NP), pau setim,

boxwood, buis brésil

Guarantá (NP)

Arapoca (NP)

Arapoca branca (Freise)

Guatambú (NP), guatambu

blanco, piquiá marfim (Freise)

Freise (1936) described fifteen cases of dermatitis caused by these satinwood or boxwood substitutes, and two similar cases from the better-known *Fagara flava* (103). Most of the eruptions were mild and confined to the finger-webs and other exposed areas, as the sawdust of fresh wood is coarse and does not penetrate under the clothes. Some were more severe, however, with widespread oedema accompanied by general symptoms, usually going on to vesicular dermatitis and often gangrenous ulcers which in three cases proved fatal. Freise confirmed the irritant action of the sawdust on his own skin and on laboratory animals.

Guarantá and amarelo contain the photosensitizer xanthotoxin, and guatambú contains balfourodin and other alkaloids (Hausen, 1970).

105. *Amyris balsamifera* L.

(*A. toxifera* Willd.)

A. simplicifolia Karst. et spp.

Torchwood (NP), amyris, quigua,

Venezuelan or W. Indian

sandalwood

Candil, candlewood, torchwood

Amyris spp. used to be considered one of the main sources of rosewood (Holtzapffel & Royle, 1843; Burn, n.d.), but now provide very little timber (Record & Hess, 1943). Grossmann (1920) claimed that working with *Amyris* and some other rosewoods (see 47) caused headache, weakness, drowsiness, dyspnoea and sometimes dermatitis. Amyris oil, a substitute for sandalwood oil, was formerly extracted from the wood on a large scale (Record & Mell, 1924). *A. opobalsamum* (not a tree) is the source of Balm of Mecca (Genders, 1972), which was a favourite beauty preparation in the Middle East but could produce alarmingly violent reactions on the face (Montagu, 1717).

106. *Citrus limon* (L.) Burm. f.

C. aurantium L. et spp.

C. medica L.

Lemonwood, zitronenholz

Orangewood

Citron, citronnier

Citronnier used to be popular with French cabinet-makers (Hinckley, 1960), but in Germany the name zitronenholz has been much more widely applied. It seems to have referred mainly to satinwoods (103, 108) with a lemon scent (Gayer, 1928), which were probably responsible for most if not all of the reported cases of zitronenholz dermatitis. Grossmann (1920) doubted

whether genuine *Citrus* wood ever caused skin irritation. Janson (1953) refers to one case of wood dermatitis in a paper on citrus fruit dermatitis, but unfortunately gives no details.

Walker (1921) mentions a case of asthma due to orangewood sawdust used for polishing jewels, but no skin tests were done.

FLINDERSIACEAE

107. *Flindersia australis* R.Br.

Crow's ash, moah, Australian teak

F. brayleana F.Muell.**Queensland maple**, Australian maple, maple silkwood*F. pimenteliana* F.Muell.

Pflanz (1908) reported dermatitis of the face, hands and arms in woodworkers using Australian moah, but he could not reproduce the eruption with sawdust or extracts, either on the patients or himself. Matthes & Schreiber (1914) also investigated the wood, which they differentiated clearly from 'African moah' (see 191), but they could find no irritants in it either. It is hardly exported now.

MacPherson (1925b) described dermatitis on the face, neck, hands and forearms of a cabinet-maker using Queensland maple, identified as *F. chetawaiana* Bail. None of his workmates had dermatitis, but the dust made some cough and sneeze. No patch tests were made.

Ritchie (1964) examined in detail the wood of fourteen Australian *Flindersia* spp., finding flavonoids, coumarins, furoquinolines, alkaloids, triterpenoids, etc. Their physiological actions were not investigated.

108. *Chloroxylon swietenia* D.C.**Ceylon satinwood**, E. Indian s., citronnier Ceylan (NP), atlaswood, citronwood

Jones (1904) reported two outbreaks of dermatitis in cabinet-makers working with East Indian satinwood in Glasgow shipbuilding yards. Not all men exposed were affected. The latent period became shorter in successive attacks. Legge (1907) wrote: 'there can be no doubt that East Indian satinwood possesses much more irritant properties than the West Indian variety'. Bidie (1905), however, maintained exactly the opposite. Both types of satinwood had been imported into England since about 1780 (Sheraton, 1803) and there was no attempt at conservation, so that genuine satinwoods were increasingly replaced by substitutes. This may have been one factor producing fluctuations in toxicity; perhaps an element of photosensitivity was another (see 103).

Auld (1909) found among other substances in the wood the alkaloid chloroxylonine, which Cash (1911) investigated for toxic properties. At first he found it had no effect on his skin, but at the second attempt 10 days later a reaction appeared after 22 days, and at the third attempt after only 40 min. Another subject was sensitized in the same way by repeated tests, but a third remained unaffected. *C. swietenia* also contains possible photosensitizers (see 103). Hausen (1970) suggests that the sensitization Auld observed might really have been due to these and other contaminants.

PTAEROXYLACEAE

109. *Ptaeroxylon obliquum* (Thunb.) Radlk.
(*P. utile* Eck. & Z.)

Sneezewood, paco (NP), nieshout,
umtati

The sawdust of umtati has a strong peppery smell and causes violent sneezing, which restricts its commercial use (Boulger, 1908; Chalk *et al.*, 1935). The substance responsible is the hydroxycoumarin nieshoutol (McCabe *et al.*, 1967; Murray & Ballantyne, 1969).

SIMAROUBACEAE

110. *Quassia amara* L.

Quassia, Surinam quassia,
bitterwood
Jamaica quassia, bitterwood

Aeschrion excelsa (Sw.) Kuntze
(*Picraena excelsa* Lindl.,
Picrasma excelsa Planch.)
Simarouba amara Aubl.

Simaruba, marupa (NP),
bitterwood
Tree of Heaven

Ailanthus altissima (Mill.) Swingle
(*A. glandulosa* Desf.)

Barham (1794) said that workmen disliked working with Jamaica quassia because it 'bittered' their mouths and throats, and Stone (1921) quoted an account of temporary paralysis in a dog's legs after its ulcers had been bathed with a decoction of the wood. These reports hardly seem to justify Moll's (1950) claim that it is the 'most-feared' wood of S. America, for which he quotes no evidence.

Many Simaroubaceae contain bitter principles such as quassine and neoquassine, and both quassias are used medicinally. The traditional method is to stand water overnight in a cup made of quassia wood and drink it in the morning. The bark of *S. amara* and *Khaya senegalensis* (114) and the wood of *Picrasma crenata* and (probably) *Q. amara* also contain 2,6-dimethoxybenzoquinone (Polonsky & Lederer, 1959). This was one of the quinones that gave positive patch tests in Heyl's patient with sucupira dermatitis (82).

Negroes stripping the root-bark of simarouba (perhaps not *S. amara*) wore protective clothing because the sap would cause *gale* severe enough to prevent them walking for some days (Préfontaine, 1763). There seem to be no recorded reactions to the timber, which is the only one of the family used commercially.

Gardeners pruning the Tree of Heaven may get vesicular eruptions on the face and hands (Cornevin, 1887). It is often planted ornamentally in the U.S.A. but its timber is useless (Record & Hess, 1943).

BURSERACEAE

111. *Aucoumea klaineana* Pierre

Gaboon, okoumé (NP), angouma,
Gaboon mahogany

Spitzer (1927) reported dermatitis of the exposed skin in a furniture maker working with okoumé. Patch tests were positive on a control subject with eczema and negative on a normal control, but were not done on the patient. Subiza (1958) found that nearly all the workers exposed to a

batch of 'okumen carcomido' had conjunctivitis and severe nasal irritation, but few had skin irritation.

One patient with dermatitis seen at St John's gave positive patch tests with gaboon and deal (203).

MELIACEAE

112. *Toona sureni* Merr. et spp. **Burma cedar**, suren (NP), toon,
Cedrela tooni Roxb. chomcha, red cedar

The FPRL (1963) receives a few trade reports of skin irritation from this widely used wood.

113. *Swietenia macrophylla* King Honduras mahogany, Tabasco m.,
 (*S. mahagoni*) baywood
S. mahagoni Jacq. Cuban mahogany, West Indian
 or Spanish mahogany

Both species are officially called **American mahogany**, acajou amérique (NP).

American mahogany was first imported to Spain before 1600, and to England not long after. Since the eighteenth century it has been prized as a cabinet wood, but with increasing scarcity it has been gradually replaced in Europe by African mahogany (114) from the late 19th century onwards (Lamb, 1966; Record & Hess, 1943).

Czimatis & Hagemann (1910) and later authors (see Hausen, 1970) have listed mahogany as toxic without distinguishing between *Swietenia* and *Khaya*. The only satisfactory account of dermatitis certainly due to *Swietenia* sp. is that of Steiner & Schwartz (1944). They described an outbreak of rather mild dermatitis in American shipbuilders working with Tabasco mahogany. Only two of the four men patch-tested with the sawdust reacted positively, but another reacted to an ether extract. The outbreak subsided as the weather became cooler.

Grossmann (1920) thought that American mahogany was harmless, but he had seen dermatitis caused by potassium dichromate used to stain lighter mahogany substitutes. *Swietenia* is botanically so close to *Khaya*, however, that other species besides *S. macrophylla* may well prove to be allergenic.

One St John's patient gave a positive patch test with Honduras mahogany (207).

114. *Khaya ivorensis* A.Chev. } **African mahogany**, acajou
 (*K. klainei* Pierre) d'Afrique (NP), ogwango, krala,
K. anthotheca C.DC. } acajou blanc, mangona, mbawa,
K. grandifoliola C.DC. } munyama
K. senegalensis A.Juss. } Big-leaf mahogany, bissilom (NP)
 } Dry-zone mahogany, bissilom
 } (NP)
K. nyasica Stapf. } Mhangazi, E. African mahogany
 The British Standard name for all *Khaya* spp. is **African mahogany**.

The species are difficult to distinguish, especially after felling. They are often imported mixed, though *K. ivorensis* provided the bulk of the timber until recently (Rendle, 1956). The E. African species have not been reported to cause dermatitis.

Czimatis & Hagemann (1910) included *K. senegalensis* in their list of toxic timbers. There were no case reports referring specifically to *Khaya*, however, until Morgan & Wilkinson (1965) described two outbreaks of dermatitis in a furniture factory, affecting the faces, forearms and hands of men engaged in sanding and other finishing operations. Patch tests were positive with sawdust of *K. anthotheca* only, but *K. euryphylla* is now known to cross-react with it sometimes (Wilkinson, 1971). Two cases sensitive to *K. ivorensis* have since been found, but they did not cross-react with *K. anthotheca* which remains much the commoner sensitizer (Morgan *et al.*, 1968; Wilkinson, 1970). Its principal allergen is anthothecol (Fig. 7), but there may be others.

Mucosal irritation was the main feature of another outbreak described by Wilkinson (1970), but it was not certain that this was due to *Khaya*. Sosman *et al.* (1969) described asthma in a pattern-marker with positive inhalation test and precipitating antibody in the serum to 'mahogany', but as this was in New England it could have been either *Khaya* or *Swietenia*.

Shevlyakov (1969) found that fifteen of sixty-eight Russian furniture workers using 'mahogany from Congo and Ghana' (evidently not *Swietenia mahagoni* as he thought) had dermatitis on the forearms, elbow flexures, groins, face and neck rather than the hands. Patch tests were positive in five of twenty-one polishers tested.

115. *Entandrophragma utile* Sprague

Utile, sipo (NP), assié,
kalungi, mfumbi

E. cylindricum Sprague

Sapele, sapelli (NP), aboudikro

The Forestry Department in Ibadan, Nigeria, receives occasional trade complaints of irritation by utile (Wendorff, 1964). Wilkinson (1971) has seen one case of utile dermatitis in England, and one St John's patient was sensitive to utile and rosewood (217), but the wood is extensively used and the incidence of toxic effects probably low.

Brezina (1913) described a scarlatina-like eruption on the arms which followed polishing 'sapeli-mahogany', but no patch tests were made and the identification is none too certain. Two cases sensitive to sapele have been seen at St John's (214).

116. *Lovoa klaineana* Pierre ex Sprague
(*L. trichilioides* Harms.)

African walnut, dibétou (NP),
apopo, tigerwood, side

Workers in one Ibadan factory complained of nasal irritation from this wood (Woods, 1964). One man with dermatitis gave positive patch tests with African walnut and mansonina at St John's (219).

117. *Guarea cedrata* Pellegr.
G. thompsonii Sprague & Hutch.
G. laurentii De Wild.

Guarea, bossé (NP), obodo,
Nigerian pearwood, N. cedar,
cedar mahogany, bosassa

G. trichilioides L. et spp.

Cramantee (NP), muskwood

All the men in contact with guarea in one factory complained of severe irritation of the nose and throat (MacKenna & Horner, 1954). Trade complaints of skin and nasal irritation are only occasional in Nigeria (Wendorff, 1964; Woods, 1964), but common in England (Orsler, 1969). *G. thompsonii* is said to be more irritating than *G. cedrata* (Farmer, 1972).

The American species (mainly *G. trichilioides*) smell strongly of musk and their powdered bark is emetic and haemostatic (Record & Hess, 1943). They are much less important than the African ones as timber.

118. *Turraeanthus africanus* Pellegr. **Avodiré** (NP), apaya, engan,
T. vignei Hutch. & J.M.Dalz. lusamba

A few trade complaints of skin irritation have been reported to the FPRL (1963) and to Hausen (1970). Wilkinson (1971) has seen two cases of avodiré dermatitis with positive patch tests. In Ghana the sawdust is said to make woodcutters spit blood (Irvine, 1961). The wood contains one or more alkaloids (Hausen, 1970).

119. *Dysoxylum muelleri* Benth. Stavewood (NP), red bean, miva
 mahogany
D. fraserianum Benth. Rose mahogany

Cabinet-makers in Australia found that after working with red bean for 4 or 5 days 'they began to suffer from a virulent form of influenza, accompanied by violent fits of vomiting and bleeding at the nose' (Maiden, 1909). The more seasoned the wood was, the worse it became. Aldersley (1925) reported the same effects, but used the wrong botanical name for red bean (see Cleland, 1925). Bisset (1949) vividly described his own similar symptoms, accompanied by painful breathing, headache and anorexia from which he did not fully recover for 4 days, after sawing up the wood to obtain dust for extraction. He found white deposits in the parenchyma cells of *D. muelleri* but not of non-irritant species of *Dysoxylum*, and intended to examine them pharmacologically.

The sawdust of *D. muelleri* and *D. richii* can cause eczema (Maiden, 1909; Nomenclature Générale, 1965). *D. fraserianum* and other species are also toxic (Hausen, 1970).

120. *Sandoricum indicum* Cav. et spp. **Katon**, kra-thon (NP), sentul,
 ketjapi, thitto

MacKenna & Horner (1954) described sneezing, epistaxis, tightness of the chest, body-aches, 'marked mental dimness' and bradycardia which affected four men sawing katon, and to a lesser degree other men nearby and the investigating physician. There was no dermatitis. The heartwood contains the triterpene katononic acid (King & Morgan, 1960).

121. *Amoora polystachya* Hook. f. & Jackson **Tasua** (NP), amari, goi
A. cucullata Roxb. et spp.

The FPRL (1963) has received a few trade reports of skin and mucosal irritation and general symptoms.

EUPHORBIACEAE

122. *Euphorbia tirucalli* L. Milk-hedge
E. continifolia L. Lechero
E. candelabrum Trem.

Caustic milky sap is characteristic of the Euphorbiaceae, and their timber is so troublesome to fell and work that few species are exported. Dermatitis from the wood of *E. candelabrum* which was used in Somalia for making caskets was described by Lipparoni (1951), and from the sap

of other species by Raymond (1936), Blohm (1962) and others. The latex contains a number of tetracyclic triterpenes (euphol, euphorbol, cycloartenol, etc.) and other substances, the physiological actions of which do not seem to have been studied (Ponsinet & Ourisson, 1968).

123. *Hippomane mancinella* L.

Manzanillo (NP), manchineel,
beach apple, arvore da morte

The manchineel is one of the most notorious of all irritant trees, and has accumulated an extensive mythology (Bodeau, 1936). Soldiers training in the West Indies during the last war often had bullous dermatitis and severe conjunctivitis after accidental contact with the sap (Satulsky & Wirts, 1943; Grana, 1946). The irritant can be effectively removed from the skin within 30 minutes by soap and water, or more traditionally by plain sea-water as the tree is usually found on or near beaches (Snow & Harley, 1944).

Woodcutters char the bark before cutting the tree down (Barham, 1794; Allen, 1943). The wood is used locally for turnery and cabinet-work, but the sawdust causes rhinitis and cough and some men refuse to work with it (Earle, 1938).

124. *Hura crepitans* L.

Hura, assacú (NP), sandbox,
possentrie, possumwood,
javillo, sablier, ceiba blanca

Possen- and possum-tree are corruptions of poison tree (Record & Mell, 1924).

'The fellers, as they cut them down, are very careful of their eyes; and those that have Cipers [kerchiefs], put it over their faces; for if any of the sap fly into their eyes, they become blind for a month.' (Ligon, 1673). Sandbox sap causes blisters and erysipelas-like eruptions (Pardo-Costello, 1923; Allen, 1943), but the wood is exported and has produced dermatitis in Europe (Hausen, 1970). It was one of the first toxic woods to be chemically investigated. Boussingault & Rivero (1825), working in Bogotá, found a vesicant essential oil in the latex, the vapour from which inflamed their faces severely while it was being boiled down. Richet (1909, 1910) studied anaphylaxis provoked in animals by an albuminoid extract of the latex which he called crepitine, but this was not the irritant principle. The latex contains complex triterpenes like those of *Euphorbia* species (Ponsinet & Ourisson, 1965).

125. *Spirostachys africanus* Sond.
(*Excoecaria africana* M.Arg.)
Excoecaria agallocha L.

African sandalwood, sandalo
africano, tambootie, tomboti
Geor (NP), aloewood,
blind-your-eye

Small boxes and ornaments are made locally from African sandalwood, which is also one source of sandalwood oil. The sawdust irritates skin and mucosae (Codd, 1951; Pardy, 1954), and yokes made of the wood had to be discarded because they inflamed the oxen's necks (Davy, 1929).

The sap of geor blisters woodcutters (Behl & Captain, 1966) and the wood is said to irritate skin and eyes even when dry (Lewin, 1928).

126. *Croton megalocarpus* Hutch.
Sapium ellipticum Pax.

Musine
Tomi

Musine has been used in England for flooring. Its fresh wood has an objectionable smell, and the sawdust irritates the nose and throat of some workmen (Anon., 1951).

Several *Sapium* spp. contain vesicant latex, but none produces timber of commercial importance (Standley, 1927; MacMillan, 1957; Irvine, 1961; Lewin, 1962).

BUXACEAE

127. *Buxus sempervirens* L.

B. macowanii Oliv.

European boxwood, Abassian-,
Iranian-, Turkey-boxwood
East London boxwood, Cape
boxwood

Markin (1930) reported asthma with a positive scratch test with box sawdust in a watchmaker who used it to clean gold. Contact dermatitis from the leaves was described by White (1889) and Oppenheim (1913), but the only two cases ascribed to the wood are Nestler's (1929) with very dubious identification, and Nordin's (1947), a very brief account without patch tests. Grossmann (1920) thought mild general symptoms could follow prolonged work with boxwood.

Several unrelated boxwood substitutes are toxic (104, 183, 195). The Australian boxthorn mentioned by Cleland (1914) is not *Buxus* but probably *Bursaria spinosa* (Boulger, 1908; Baker, 1919).

ANACARDIACEAE

128. *Anacardium excelsum* Skeels
A. occidentale L.

Espavel (NP), cashew, cajú,
caracoli, maranon

The shell of the cashew nut from *A. occidentale* is a strong sensitizer (Préfontaine, 1763; Downing & Gurney, 1940; Behl & Captain, 1966), and the wood perhaps also causes dermatitis (Lewin, 1928). The active principle is cardol (Fig. 2). *A. excelsum* produces more important timber, but there are no reports of dermatitis from this.

129. *Gluta renghas* L. et spp.
Melanorrhoea laccifera Pierre
M. wallichii Hook.f. et spp.

Rengas (NP), gluta, rak, son,
torotoro, Singapore mahogany

M. usitata Wall.

Theetsee, Burma lacquer

Rengas is the Malay name also for several species of *Semecarpus* (139), *Melanochyla* and *Swin-tonia*, the common factor being highly irritant sap which rapidly blackens on exposure to the air (Burkill, 1935; Corner, 1952). The attractively figured wood is now little exported because of its toxicity, but it may have been the source of the Borneo rosewood (Gimlette, 1929) and magenta rosewood which caused dermatitis described by Legge (1906, 1907). Men coat their skin with coconut oil before felling the tree and then leave the trunk to dry before cutting it up, but even dry wood in old furniture can produce very irritating dust (Ridley, 1922). The latex contains glutarenghol and thitsiol (Fig. 2) (Majima, 1922; Schwartz *et al.*, 1945).

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|------------------------------------|--------------------|
| 130. <i>Mangifera caesia</i> Jack. | Binjai, wild mango |
| <i>M. lagenifera</i> Griff. | Lanjut |
| <i>M. odorata</i> Griff. | Kwini |
| <i>M. indica</i> L. | Mango |

Corner (1952) considered the sap of binjai and lanjut the most poisonous and that of the common mango harmless, but he did not distinguish between irritation and sensitivity. Patients with dermatitis from mango fruit in fact react strongly to the sap, and also cross-react with poison ivy and pentadecylcatechol (Simmons & Bolin, 1921; Keil *et al.*, 1946). *Mangifera* spp. produce no timber for export, but dermatitis from kwini wood has been reported in Malaya (Ridley, 1922). The smoke from a fire of binjai branches caused dermatitis in several people (Landor, 1943).

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|--------------------------------|-------------------------|
| 131. <i>Spondias mombin</i> L. | Mopé (NP), mombin, jobo |
|--------------------------------|-------------------------|

A Nigerian sawyer developed mild papular dermatitis on exposed skin. After it had subsided he was patch-tested with sawdust from seven woods he had recently worked with. *S. mombin* gave a positive (+ +) reaction, and *Pterygota macrocarpus* and *Terminalia ivorensis* slight ($\pm$) reactions. No other Anacardiaceae were available to test for cross-sensitivities (Woods, 1964).

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|------------------------------------|----------------------------------|
| 132. <i>Rhus vernicifera</i> DC. | Japanese lacquer tree |
| <i>R. striata</i> Ruiz & Pavon | Manzanillo |
| <i>R. toxicodendron</i> L. et spp. | Poison ivy, poison oak |
| <i>Cotinus coggygria</i> Scop. | Wig tree, fustic wood, fisetholz |
| (<i>Rhus cotinus</i> L.) | |

The lacquer of *R. vernicifera* is the most toxic of those produced by the Anacardiaceae, containing urushiol (Fig. 2) (Majima, 1922). It was known to cause dermatitis in the seventh century in China (Toyama, 1918) and in the eighteenth century in England, when cabinet-makers called it the Indian varnish (Bateman, 1819). The wood is not exported but has been used for cabinet-making in Japan (Yoshida, 1884). In North Vietnam shoes made of its cause dermatitis, and when used for firewood it produces smoke with highly irritating particles (Holcik, 1959).

In Venezuela, *R. striata* is called palo hinchon: 'the tree which swells', from the effect on the skin of its wood and sap (Hurtado, 1965, 1968). The North American species of *Rhus* (Dawson, 1954; Kligman, 1957) produce no wood large enough to be useful.

The wood of *Cotinus coggygria* has been known to cause dermatitis and general symptoms when cut for veneers (Hausen, 1970), but it is more often used as the source of the yellow dye fustic.

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|--|---------------------------------|
| 133. <i>Metopium brownei</i> (Jacq.) Urban | Checham (NP), black poisonwood, |
| (<i>M. toxiferum</i> Krug. & Urb., | doctor's gum |
| <i>Rhus metopium</i> L.) | |

The bark causes blistering and ulcerating dermatitis in those who fell the tree (Pardo-Costello, 1923). The wood is harmless, but is only used locally (Record & Hess, 1943).

134. *Lithraea caustica* Hook. & Arn.
L. brasiliensis March.

Lithi, litre, hualtaco, aroeira

'In Chili, there is a very common tree called licti, the shade whereof causes the bodies to swell of those that sleep under it; but more especially the face, so that they cannot see out of their eyes' (Barham, 1794). Later authors confirmed that the sap, and at certain times of year the exudate from the leaves, are highly irritant (Sprague, 1921). When the wood is dry it is said to be harmless and has been used for cabinet-work (Webster, 1911), but some dermatitis occurs even then (Hausen, 1970). See also 136.

Lima (1953) and Hurtado (1968) studied cross-sensitivity between *Lithraea* spp., *Rhus* spp. and other S. American Anacardiaceae such as *Mauria puberula*.

135. *Schinopsis lorentzii* Engl.
S. balansae Engl.

Quebracho colorado (NP), red q.,
 san juan, pau mulato

In Santiago, dermatitis from the leaves, branches or sawdust of this tree is called paaj or mal de quebracho (di Lullo, 1928, 1934). It lasts 5-10 days, and is often accompanied by fever, headache and anorexia. Patch tests with the leaves or an alcoholic extract were positive in nearly half the local people tested in Chile.

The very hard wood (quebracho means axe-breaker) is used more for tanning than timber. White quebracho is an unrelated species of *Aspidosperma* (179).

136. *Schinus terebinthifolius* Raddi
S. molle L.

Aroeira
 Pepper-tree

Von Bassewitz (1928) wrote at length about dermatitis, conjunctivitis and mucosal irritation caused by aroeira in Brazil, and the folklore surrounding it. Like Freise (1932), he thought it was probably a species of *Schinus*, but *Astronium* (137) and *Lithraea* (134) are also called aroeira.

137. *Astronium fraxinifolium* Schott
A. graveolens Jacq. et spp.

Gonçalo alves, urunday (NP),
 zebrawood, courbaril, locust
 wood, kingwood, tigerwood,
 guaribu, roble gateado, aroeira

In Brazil the sawdust and turpentine-like balsam of this wood and some *Schinus* spp. (136) cause an irritable weeping skin eruption, often complicated by erosions like second-degree burns (Freise, 1932). Native forestry workers believe that after the first attack they become immune to it, and Indians are always immune.

The wood often resembles that of *Dalbergia* spp. (94) and may be mixed with shipments of them (Record & Mell, 1924; Record & Hess, 1943).

138. *Smodingium argutum* E.Mey.

Um-tovane, tovana

Findlay (1963) collected seven cases of dermatitis from the sap of this small tree in S. Africa, some with positive patch tests. It contains at least two unsaturated heptadecylcatechols similar to those of poison ivy (Findlay *et al.*, 1974). The timber is of no importance.

139. *Semecarpus anacardium* L.f. Indian marking-nut, bhilawa
S. venosa Volk. Aangot
S. australiensis Engl. Tar tree
Blepharocarya involucrigera F.Muell. Bolly gum, rose butternut

The fruits of the marking-nut tree cause dhobie-mark dermatitis (Livingood *et al.*, 1943; Behl & Captain, 1966). 'The wood contains an acrid juice which causes swelling and irritation, and timber-cutters object to felling it; it is not used' (Gamble, 1902). The sensitizers are semecarpol and bhilawanol (Pillay & Siddiqui, 1931). The sap of the tar tree (Flecker, 1945) and the related bolly gum produce dermatitis in Australia (Cilento, 1944; Webb, 1948a). Other skin-sensitizing species are *S. venosa* in Japan (Iseki, 1932) and *S. laxiflora* in Melanesia (Record, 1945).

CELASTRACEAE

140. *Euonymus europaeus* L. Spindle tree

The bark, leaves and fruit contain a toxic glycoside (Cornevin, 1887; Santavy & Reichstein, 1948), but there is probably little of it in the wood, which used to be a favourite material for cups, casks and especially meat-skewers (Loudon, 1844; Boulger, 1907).

ACERACEAE

141. *Acer saccharum* Marsh. et spp. **Maple**

Maple-bark disease is a pulmonary hypersensitivity reaction to the fungus *Cryptostroma corticale*, with cough, night sweats and radiographic evidence of infiltration (Emanuel *et al.*, 1966). A similar disease caused by *Alternaria* spores from other types of wood was described by Schlueter *et al.* (1972). No published evidence has been found to support Weber's (1953) listing of maple as a skin irritant.

RHAMNACEAE

142. *Colubrina ferruginosa* Brogn. et spp. Bois pelé (NP), snakebark,
 bois serpent, ironwood, sobragy

Vorreiter (1949/1958) lists this locally-used West Indian wood as a cause of vomiting, diarrhoea and cramps, but quotes no source. No other reference to toxic effects has been found.

MALVACEAE

143. *Hibiscus elatus* Sw. Blue mahoe, majagua

The wood smells peppery when worked and causes sneezing (Stone, 1924; Record & Mell, 1924).

STERCULIACEAE

144. *Nesogordonia papaverifera* Capuron **Danta**, kotibé (NP), epro,
(*Cistanthera papaverifera* A.Chev.) otutu, ovové, aborbora
Some complaints of irritation by this wood are received by the Forestry Dept. in Ibadan
(Wendorff, 1964).

145. *Sterculia caribaea* R.Br. Chicha (NP), maho, bois de caca
S. oblonga Mast. **Yellow sterculia**

MacKenna & Horner (1954) include maho among the woods whose 'chief, if not only, effect is on the skin'. Anon. (1957) and Zafiropoulo *et al.* (1968) also list it, but no case reports have been found.

Yellow sterculia has a strong disagreeable odour when fresh (Farmer, 1972), a characteristic of the genus reflected in the names sterculia and bois de caca. Karaya and other gums from *Sterculia* spp. have been reported to cause asthma, rhinitis and urticaria (Feinberg & Schoenkerman, 1940; Bowen, 1939).

146. *Triplochiton scleroxylon* K. Schum. **Obeche** (NP), wawa, abachi,
African whitewood, samba

Bridge (1937) reported a case of asthma due to the sawdust, skin tests being positive with obeche and negative with other woods. Oehling (1963) described three cases of obeche asthma (one also sensitive to limba, 159) with positive intradermal, inhalation and Prausnitz-Küstner tests. He described contact urticaria, which could be reproduced by rubbing the skin with a slip of obeche but not with other woods, and also found positive ID tests with it in many asthmatic subjects who had been exposed to obeche sawdust but did not react to it clinically.

The FPRL (1963) has five trade reports of asthma and general symptoms, but none of skin eruptions. Wilkinson (1971) has seen a case of dermatitis from a lavatory seat made of obeche, with positive patch test. Hausen (1970) found no alkaloids or quinones in the wood.

147. *Mansonia altissima* A.Chev. **Mansonia**, bété (NP), aprono,
ofun, koul, Nigerian walnut

Mansonia was introduced from Nigeria into the world market in the thirties, but its irritant properties soon became notorious (Bridge, 1935). Nearly all men exposed to the fine dust through sawing and especially sandpapering complained of sneezing and sore throat, and many had nosebleeds and headache. Some also developed dermatitis on exposed skin with positive patch tests (Horner & Wigley, 1936; Bourne, 1956). Salamone *et al.* (1969) also found skin irritation with a follicular eruption in a minority of their patients, but patch tests were negative. Mucosal irritation affected many more. Despite exhaust ventilation and other precautions mansonia is still considered a troublesome wood to work (Orsler, 1969) and this restricts its use to some extent (Rendle, 1969; Farmer, 1972). Four cases of mansonia dermatitis have been seen at St John's (208).

Mascreé & Paris (1939) found in the bark a cardiac glycoside which they called mansonine. Several other glycosides related to strophanthin have since been found in the bark and heartwood (Frèrejacque, 1951; Sandermann & Dietrichs, 1959). Sandermann & Dietrichs also isolated

mansonina-quinone (Fig. 3) from the heartwood and showed by patch tests that it was the skin-sensitizer in their case. Schulz (1962) obtained positive patch tests with mansonina-quinone in three more patients who gave negative results with the glycosides and other constituents. At least nine quinones have now been isolated, and shown to have a sesquiterpenoid structure (Marini-Bettolo *et al.*, 1965; Galeffi *et al.*, 1969).

148. *Heritiera utilis* Sprague
(*Tarrietia utilis* Sprague)
H. simplicifolia Mast. Kosterl.
Tarrietia cochinchinensis Pierre

Niangon (NP), ogoué

Mengkulang (NP)
Chumprak

Raymond (1959) had seen skin trouble caused by niangon, but gave no details. The sawdust of chumprak irritates the throat and nose (Timber Development Association).

149. *Pterospermum indicum* is an incorrect name given by Lewin (1928) to Amboina wood, which is in fact *Pterocarpus indicus* (93). He mentions another *Pterospermum* sp. used as a fish poison, but it produces no commercial timber.

OCHNACEAE

150. *Lophira alata* Banks ex Gaertn.f.

Ekki, azobé (NP), bongossi

Hausen (1970) quotes a trade report (without clinical details) that the wood can cause itching.

GUTTIFERAE

151. *Mesua ferrea* L.

Gangaw (NP), mesua, ironwood,
vap, nagasari

Lewin (1928) said that this S.E. Asian wood was suspected of being poisonous, but did not say why. It contains xanthenes similar to those in *Calophyllum* and *Mammea* (Govindachari *et al.*, 1967; Chow & Quon, 1968).

152. *Mammea africana* Sabine

Oboto (NP), djimbo, bom' pegya,
ologbomidu, mbossi, bokoli

This little-exported wood is said by Nigerian woodworkers to cause 'skin itches' (Wendorff, 1964). *M. americana* contains xanthenes like those in *Mesua* (Chow & Quon, 1968).

153. *Calophyllum brasiliense* Camb.
C. brasiliense var. *rekoi* Standl.

Jacareuba, kurahura, galba
Santa Maria (NP)

Freise (1932, 1936) reported that the moist sawdust of jacareuba, especially older trees, caused persistent dermatitis and folliculitis in Brazilian woodworkers. It contains the pyranoxanthone jacareubin (King *et al.*, 1953) and several other xanthenes (Pereira *et al.*, 1966).

- 154.
- Caraipa densiflora*
- Mart. et spp.

Tamacoari (NP), laksiri

'The sap of the bark and sapwood is said to be so caustic as to blister the skin' (Record & Mell, 1924; Record & Hess, 1943).

DIPTEROCARPACEAE

- 155.
- Dipterocarpus*
- spp.

Keruing, gurjun, yang (NP)*Shorea assamica* Dyer et spp.**White meranti**

Skin irritation from keruing is occasionally reported to the FPRL (1963) (Orsler, 1969). It is said to cause both skin and mucosal irritation in Germany (Wagenführ, 1961). The wood contains the sesquiterpene lactone α -gurjunene (Hausen, 1970).

Hublet *et al.* (1972) include meranti among woods which cause skin or mucosal irritation in Belgian woodworkers, but give no details.

FLACOURTIACEAE

- 156.
- Gossypiospermum praecox*
- P.Wils.

Maracaibo boxwood, zapatero*(Casearia praecox* Griseb.)

(NP), Venezuelan or W. Indian boxwood, limoncillo

At a Manchester BMA meeting in 1902 Dr T.F.Young described irritation of the throat and eyes by 'Maracaibo boxwood', which was incorrectly (see Record & Mell, 1924) identified as *Tabebuia pentaphylla* (Oliver, 1908). There was at that time great confusion over the sources of various boxwood substitutes; see *Nauclea* (195) and especially *Gonioma* (183), which may well have been the real culprit in Young's cases. True Maracaibo boxwood is still widely used and there have been no further reports of toxic effects from it.

THYMELAEACEAE

- 157.
- Gonystylus bancanus*
- Baill. et spp.

Ramin (NP), melawis

'It is reported that men handling logs develop skin irritation, probably due to penetration of the skin by sharp-pointed bark fibres remaining on the log. Washing the hands with soap and water is apparently an effective remedy.' (Farmer, 1972). Wilkinson (1973) has seen a case of contact dermatitis from the sawdust, however, with positive patch test. Oehling (1963) found one case of 'sensitivity' (no clinical details), and thirteen men gave positive intradermal tests with ramin extract but had no symptoms on working with it. Salamone *et al.* (1969) called ramin one of the more toxic woods but gave no details. Hausen (1970) quotes trade reports of asthma and skin irritation from the sawdust and bark. The related *Daphne mezereum* and *Dirca palustris* have highly irritant bark which has been used medically as a rubefacient (Woods, 1962; Muenscher, 1951).

One St John's patient gave a positive patch test with ramin wood (212).

LECYTHIDACEAE

158. *Lecythis pisonis* Mart.
L. grandiflora Aubl.
 (*L. ollaria* L.)

Sapucaia (NP), canari macaque,
 couatapatou, tobago, maho jaune

According to Freise (1932) sapucaia has to be soaked in a mixture of urine and soda for several days before being worked, because the saponin in the fresh wood causes severe mucosal irritation, headache and vomiting. The seeds in the well-known 'monkey-pot' fruit contain a toxic selenium compound, selenocystathionine (Aronow & Kerdel-Vegas, 1965).

COMBRETACEAE

159. *Terminalia superba* Engl. & Diels

Limba (NP), **afara**, ofram, akom,
 fraké, korina, noyer du Mayombe
Indian laurel (NP)

T. alata Roth. et spp.

Limba splinters are said in Germany to cause troublesome wounds with prolonged suppuration (Sander mann & Barghoorn, 1956). Nordin (1947) reported vesicular eczema of the finger apparently due to limba sawdust, and Hausen (1970) mentions other brief reports but no convincing ones with patch tests. Oehling (1963) had two cases of asthma in whom urticaria could be provoked by inhaling limba sawdust or by rubbing slips of limba wood on their skin. Fifteen of 220 woodworkers gave positive intradermal tests with limba extract, though only ten of them had any symptoms when working with the wood.

Hausen (1970) found no alkaloids or quinones in limba, but King *et al.* (1954, 1955) found triterpenes in *T. arjuna* and *T. ivorensis*. *T. ivorensis* (Zafiropoulos *et al.*, 1968), *T. australis* (Hanslian & Kadlec, 1966) and *T. chebula* (Bernhard-Smith, 1923) have been listed as toxic, without case-reports.

One St John's patient gave a positive patch test with *T. alata* (205).

160. *Combretum kraussii* Hochst.

Mdubu, umbubu

Several convincing cases of dermatitis from sawing the fresh wood were described by Marsh and other forestry workers in Pretoria, though no patch tests were made (Hausen, 1970).

MYRTACEAE

161. *Eucalyptus maculata* Hook.
E. citriodora Hook.
E. leucoxylon F.v.M.

Spotted gum (NP), macula
 Lemon-scented gum, (spotted gum)
 South Australian blue gum

Maiden (1909) wrote that in some parts of Queensland timber-getters and sawyers had 'spotted-gum rash', though in other areas no one had heard of the condition. The bark of *E. macrorrhyncha* and *E. hemiphloia* irritates the skin, and the sawdust of *E. leucoxylon* causes spasmodic rhinorrhoea (Cleland, 1925). Cleland also mentioned a case of irritation by karri wood (*E. diversicolor*) but thought it might have been due to arsenic with which it had been treated. Eucalyptus oil can cause dermatitis (Galewsky, 1905) and is poisonous on ingestion (MacPherson, 1925a; Cleland, 1925).

162. *Melaleuca leucadendron* L.*M. linariifolia* SmithNiaouli (NP), gelam, tram,
cajeput, paper-bush, bottle-brush
Paper-barked tea tree

The bark of *M. leucadendron* is used as a rubefacient in India (Behl & Captain, 1966), and cajeput oil can cause dermatitis and folliculitis (Simons, 1953). Irritation by the bark of *M. linariifolia* was described by Maiden (1916).

163. *Backhousia myrtifolia* Hook. & Harv.
(*B. australis*)

Australian lancewood, grey myrtle

Splinters of another Australian lancewood, *Acacia shirleyi* (60), were said to cause painful wounds 'like snakebite' (Maiden, 1919). 'Lancewood' has since been included in lists of toxic timbers, and this seems to be the reason for the listing of *Backhousia* and two other 'lancewoods', against which there is no published evidence: *Curtisia dentata* (166) and *Oxandra lanceolata* (Sw.) Baill.

PSILOXYLACEAE

164. *Psiloxylon mauritianum*

Scratchwood, bois à gratter

Dust from the crumbling bark causes itching and gives the wood its name (Stone, 1921). It is hardly exported from Mauritius.

CRYPTTERONIACEAE

165. *Dactylocladus stenostachys* Oliv.**Jongkong** (NP), merebong,
medang tabak

The FPRL (1964) has received some trade reports of 'irritation' and one of nosebleeds due to this wood. The name 'tabak' used in Sarawak suggests that it is known there as a nasal irritant (see 190).

CORNACEAE

166. *Cornus sanguinea* L. et spp.*Curtisia dentata* (Burm.f.) C.A.Sm.
(*C. faginea* Ait.)**Dogwood**

Cape lancewood, assegai wood

The leaves of dogwood are irritant (Nestler, 1913) but there are no reports of ill-effects from the wood. It makes 'the best skewers for Butchers because it does not taint the Flesh' (Evelyn, 1664).

There is no evidence that Cape lancewood is toxic (see 163).

SAPOTACEAE

167. *Madhuca longifolia* (Koen.) H.J.Lam.*M. utilis* H.J.Lam.(*M. indica*, *M. latifolia*)Mahua, mowa, moah, bitis (NP),
pali, butter tree

The nomenclature is a muddle. The genus *Madhuca* used to be called *Bassia* or *Illipe*, but there

was never any doubt that it belonged to the Sapotaceae. Hausen (1970) confused it with another genus *Bassia*, of the Chenopodiaceae. The moah-wood or edelteak which Matthes & Schreiber (1914) identified as *Illipe longifolia* (or *I. latifolia*) was later shown by Record (1925) to have been *Paratecoma peroba* (191). To make matters worse, the Australian *Flindersia* (107) was also called moah at that time (Pflanz, 1908).

All the lists which include *Bassia*, *Illipe* or *Madhuca* as toxic woods appear to stem from Matthes & Schreiber's mistake. The wood is little used (Boulger, 1908). The gummy juice from the bark can cause dermatitis, however, and the residue after expression of edible oil from the flower-meal irritates wounds and mucosae, perhaps containing a saponin (Lewis, 1962; Behl & Captain, 1966).

168. *Calocarpum mammosum* (L.) Pierre

Mamey, sapote

Its sap is caustic and vesicant (Allen, 1943) but the wood is little used. The related sapodilla (*Achras zapota* L.) is sometimes exported, but it has harmless sap which is used in the manufacture of chewing gum.

169. *Manilkara bidentata* A.Chev.

M. huberi Standl.

(*Mimusops* spp. Ducke)

Chrysophyllum cainito L. et spp.

Lucuma procera Mart.

L. spp.

Balata rouge (NP), bullet wood,
massaranduba, assapookoo

Uajara, guajara, uaca, satin-leaf,
star-apple, aguay

Massaranduba (branca), assapoko

Abiurana

Freise (1932) wrote that the fine dust produced in making veneers from this group of woods, the nomenclature of which is confused, produced erythema, vesiculation and painful swellings in the skin. Stone (1921) quotes an obscure reference ('Barham', but not found in the *Hortus Americanus*) to the effect that assapookoo is very poisonous. The latex from massaranduba is edible, however (Record & Mell, 1924).

170. *Tieghemella heckelii*

(*Mimusops heckelii* Hutch. & Dalz.,

Dumoria heckelii A.Chev.)

T. africana

Makoré (NP), baku, African
cherry, cherry mahogany

Douka, okola, ukola, makoré

Malespine (1935) stated that makoré caused dermatitis and mucosal irritation, but gave no details. Turc *et al.* (1950) reported two cases of coryza, conjunctivitis and dermatitis in men sawing it. Sandermann & Barghoorn (1955) described dermatitis, worst on the neck and flexures, in a joiner working with makoré who relapsed on working with it again. They found that the wood contained 5.2% of a saponin, the aglycone of which was bassic acid (Fig. 1). Patch tests on controls with makoré sawdust and the saponin were negative. The patient gave a positive patch test with the sawdust but was not tested with the saponin. King *et al.* (1955) came to the same conclusions about the structure of the saponin.

The irritant effects of makoré are now well known in the trade and tend to discourage its use (Nomenclature générale, 1965; Farmer, 1972). Dantin-Galleo *et al.* (1952) described severe

nasal and respiratory irritation with haemoptysis in men sawing woods from Spanish Guinea, probably mainly *T. africana*. This is less often exported than *T. heckelii* but equally irritant (Anon., 1955; Subiza Martin, 1971).

171. *Baillonella toxisperma* Pierre
(*Mimusops djave* Engl.)

Moabi (NP), djave, njabi,
(African pearwood?)

Heilig (1957) and Hanslian & Kadlec (1966) list *M. toxisperma* as a cause of symptoms similar to those produced by makoré, but give no details.

172. *Autranella congolensis* A.Chev.
(*Mimusops congolensis* De Wild.)

Mukulungu (NP), autracon

The sawdust is considered a mucosal irritant in the trade, requiring good ventilation and dust extractors (Anon., 1954).

EBENACEAE

173. *Diospyros celebica* Bakh.

Macassar ebony, ébène Macassar
(NP), makassarholz, coromandel
Ceylon ebony

D. ebenum Koenig
(*Maba ebenus* Wight)
D. crassiflora Hiern.

African ebony

Buschke & Joseph (1927) described dermatitis of the hands, forearms and face, becoming generalized, in a man who had been planing, rubbing down and polishing makassarholz. Some of his workmates had milder attacks. Patch tests with the sawdust and an alcoholic extract were negative, but an intradermal test with an aqueous extract was positive on the patient and negative on controls. Vonkennel (1929) reported a case of dermatitis following an ebony splinter wound, but made no patch tests. Nicolas & Pétouraud (1935) described dermatitis under a bracelet of 'true ebony'. Violent persistent irritation was produced by sawdust (of Ceylon ebony?) put into snuff as a practical joke (Grossmann, 1920).

The heartwood of *D. celebicum* and *D. ebenum* contains makassars and other naphthoquinones which could well be allergenic (Hausen, 1970). The strongly vesicant quinone plumbagin has been found in the bark of several *Diospyros* spp. (Cooke & Dowd, 1952; Irvine, 1961).

OLEACEAE

174. *Olea europaea* L. et spp.

Olive

Irritation by 'olivewood' is mentioned by Legge (1907). Smith (1920) identifies this as *Elaeodendron* sp. (olive plum), but *Olea* sp. seems more likely (Boulger, 1908).

175. *Fraxinus excelsior* L. et spp.

Ash

Champion (1965) reported dermatitis in a woodcutter's wife, due to contact with her husband's working clothes. She was sensitive to the lichen *Lecanora conizaeoides* growing on ash bark, but not to the wood itself (see 24).

POTALIACEAE

176. *Fagraea fragrans* Roxb.

Tembusu, kingwood

Several men had repeated severe irritation of exposed skin when sawing a fresh log of tembusu with its bark on, but the heartwood caused no trouble. No one in the Malayan Forestry Dept. had seen toxic effects from tembusu before (Hon, 1967). Loeb extracted an irritating alkaloid from the wood (Grossmann, 1920).

The seeds of the related tree *Strychnos nux-vomica* L. are the main source of strychnine and brucine. Its wood may also contain these alkaloids but it is of no commercial importance (Gamble, 1902).

APOCYNACEAE

177. *Tabernaemontana citrifolia* L.

Chanchito

T. crassa Benth.

Ofuruma

T. macrophylla Muell. Argent.

Pequerete

Chanchito was listed as toxic by Pardo-Costello (1923). The wood of ofuruma, which has caustic latex, is used locally in W. Africa (Irvine, 1961). Pequerete has similar toxic effects to those of *Aspidosperma* spp. (179) (Freise, 1937).

178. *Alstonia congensis* Engl.

Alstonia, emien (NP), pattern-wood, stoolwood, ahun, duku, sindru

A. boonei De Wild.

There are a few trade complaints of 'irritation' by this wood, which is used a good deal in Nigeria (Wendorff, 1964). The bark contains the alkaloid echitamine, which is not known to be irritant (Irvine, 1961).

179. *Aspidosperma peroba* Fr. All. et spp.

Peroba rosa, peroba rose (NP), red peroba, palo rosa

A. vargasii A.DC. et spp.

Pau marfim (NP), pau amarello, pequia marfim, guatambú, amarilla, pequia

Peckolt (1909) referred to dermatitis caused in sawyers by the dust of *A. parvifolium* DC. According to Freise (1932, 1937) the freshly-cut wood and sap of several species of *Aspidosperma* in Brazil cause coryzal symptoms with irritation of eyes, nose and throat and general malaise. Dry, unbroken skin is not penetrated, but if the sawdust contaminates an abrasion it produces a burning vesicular eruption and general symptoms, with muscular weakness and cramps, sweating, dryness of the mouth, drowsiness and faintness. Once the wood is thoroughly dry it loses its toxicity, unless polishes or dyes in alcoholic solvents are used on it, but there are a few trade reports of skin and general effects in England from peroba rosa (Orsler, 1969). The bark and wood of *Aspidosperma* and related genera contain a number of alkaloids: macoubein (Freise, 1937), quebrachin (yohimbine), quebrachamine and physostigmine (Hausen, 1970).

The peroba grande amarella of Touraine *et al.* (1932) was probably *Paratecoma peroba* (191).

- | | |
|--|-------------------|
| 180. <i>Macoubea guianensis</i> Aubl. | Molongó |
| <i>Geissospermum sericeum</i> Benth. & Hook. | Acari rana |
| <i>Zschokkea aculeata</i> Ducke | Tucujá |
| <i>Rauwolfia pentaphylla</i> Ducke | Muirajussará rana |

These woods cause similar symptoms to *Aspidosperma* spp. and tucujá also produces asthmatic attacks (Freise, 1937). Toxic alkaloids are widespread in the Apocynaceae. Ouabaine is obtained from the wood of *Acokanthera* spp., but these are not commercial timbers (Hausen, 1970).

- | | |
|------------------------------------|--------------------------|
| 181. <i>Cameraria latifolia</i> L. | White poisonwood, maboa, |
| (<i>C. belizensis</i> Standl.) | bastard manchineel |
| <i>C. angustifolia</i> L. | |

'Both species are reputed to be highly poisonous if the sap or latex comes in contact with the body, producing bad burns and inflammation. The timber is sparingly utilized . . . without commercial possibilities' (Record & Hess, 1943).

- | | |
|--------------------------------------|---------------------|
| 182. <i>Thevetia nerifolia</i> Juss. | Amancay, campanilla |
| <i>T. peruviana</i> (Pers.) Merr. | Yellow oleander |

All parts of these shrubs and small trees contain a milky juice which causes blistering and skin inflammation in susceptible individuals (Allen, 1943), and some are used as fish-poisons. They contain the cardiac glycoside thevetin and other toxic substances. The wood is used only locally in tropical America and Africa (Grossmann, 1920; Irvine, 1961).

The related frangipani and other *Plumeria* species contain caustic latex but are hardly used for timber (Allen, 1943; Behl & Captain, 1966).

- | | |
|--|--------------------------------|
| 183. <i>Gonioma kamassi</i> E.Mey. | Knysna boxwood, kamassi |
| The name Cape boxwood is better reserved for <i>Buxus macowanii</i> (127). | |

Legge (1905, 1907) and Hay (1907) described an outbreak of alarming reactions to African boxwood used for making shuttles in Lancashire. Workers complained of irritation of the eyes and nose, headache, sleepiness, giddiness and weakness, anorexia and nausea, and some had attacks of asthma. Those exposed to the fine dust produced in finishing the shuttles were the worst affected.

Boxwoods from S. Africa (*Gonioma*) and W. Africa (*Nauclea* 195) were both in use and were not clearly distinguished in the trade, which led to confusion when Harvey Gibson (1906) investigated the outbreak. He was sent wood samples which were identified as *Sarcocephalus* (*Nauclea*), and also sawdust from which he extracted a curare-like alkaloid, but this was in fact *Gonioma* (Legge, 1905). Dixon (1911) further examined this alkaloid's action. He maintained that the men could not have absorbed enough of it to explain their symptoms pharmacologically, but suggested an idiosyncrasy. The alkaloid was probably quebrachamine (Gellert & Witkop, 1952).

The Workmen's Compensation Act of 1906 was modified to include sufferers from *Gonioma* poisoning, four of whom were compensated by 1908, but there were only five more cases in the next 20 years (MacKenna & Horner, 1954). The wood was largely replaced by American cornel and persimmon for shuttles, and for other uses by substitutes such as Maracaibo boxwood

(156) and San Domingo boxwood (*Phyllostylon brasiliensis* Cap.). *Tabebuia pentaphylla* has been wrongly included among boxwood substitutes (Record & Mell, 1924).

184. *Nerium oleander* L.

Oleander

All parts of the plant contain toxic glycosides and sometimes cause dermatitis (Allen, 1943; Behl & Captain, 1966). The sawdust has been used as rat poison, and there is at least one circumstantial account of poisoning by food cooked on oleander spits (Richard, 1843; Pelikan, 1866; Cornevin, 1887; Watt & Breyer-Brandwijk, 1962). Hausen (1970) quotes American reports of similar poisoning after barbecues by Florida and California freeways.

ASCLEPIADACEAE

185. *Periploca graeca* L.Windenhholz, hundswindenholz,
periploca

This small tree has long been considered poisonous (Loudon, 1844) and this may include the little-used wood (Lewin, 1928) but there are no case-reports. It contains the cardiac glycoside periplocin (Hausen, 1970). The related *Sarcostemma australe* R.Br. has caustic sap but produces no timber (Hurst, 1942; Webb, 1948a).

CONVOLVULACEAE

186. *Convolvulus scoparius* L. et spp.
(*Rhodorhiza scoparia* Webb)Canary rosewood, lignum rhodii,
bois de rose

Oil of rosewood used to be extracted from the rhizomes and stem-bases of this shrub from Tenerife, but they were never used as timber (Lindley, 1838; Boulger, 1908). It was replaced by a similar oil obtained from the wood of *Aniba rosaeodora* (47), the source of which long remained uncertain (Record & Mell, 1924). Grossmann (1910, 1920) reported that this wood was toxic, but called it *C. scoparius* or *Rhodorhiza*. The name seems to have caught the imagination of later authors, who have included it in almost every list of so-called toxic timbers.

EHRETIACEAE

187. *Cordia gerascanthus* Jacq.
(*C. alliodora* Cham.)
C. goeldiana Hub.**Salmwood**, canaete solera,
Ecuador laurel
Freijo (NP), frei jorge

There is no real evidence against either species. Grossmann (1920) mentioned *C. gerascanthus* as a possible source of 'rosewood', but had seen too little of it to know whether it was toxic or not. *C. goeldiana* was the name given by Schwartz (1931) to Brazilian walnut, but this was in fact *Phoebe porosa* (43) (Record & Hess, 1943).

Hausen (1970) found a number of quinones in *C. millenii* Bak. et spp. and in the related *Patagonula americana* L., but failed to sensitize guinea-pigs with one that he isolated.

VERBENACEAE

188. *Tectona grandis* L.f.

Teak (NP), teck, djati

Teak is one of the best-known toxic woods. Apart from some correspondence in the *Lancet* (1896) the first modern report was by Evans (1905), on a carpenter who had weeping dermatitis on exposed skin after working with teak, and relapsed on using it again 10 years later. Six of eight men working with him were affected, especially those producing fine dust with glasspaper. John (1913) gave a good description of dermatitis in six patients, with positive patch tests with teak sawdust and an alcoholic extract (negative on control subjects). It is unnecessary to quote all the numerous cases published since then, but Hoffmann's (1926) review is interesting.

Krogh (1962, 1964) gave a detailed account of an outbreak of dermatitis in a furniture factory, and showed that patch tests with moist sawdust often gave false positives with teak. He suggested that mechanical and chemical irritation played a part, as well as sensitization. Installation of adequate dust extraction reduced the incidence of dermatitis from 20 to 8% in the factory he studied.

Matthes & Schreiber (1914) investigated extracts of teak, and blamed its irritant action on unsaturated resinous acids. Curiously, they could find no lapachol or lapachonone, but Sander-mann & Dietrichs (1959) found these known sensitizers, together with several tectoquinones (Sander-mann & Simatupang, 1961, 1962, 1966). Schulz (1962) showed that teak-sensitive patients reacted to lapachol but not tectoquinone in patch tests; the possibility of other sensitizers in the wood could not be ruled out. He later found (Schulz, 1965, 1967) that desoxylapachol (Fig. 3) gave much stronger patch tests and was probably the principal sensitizer in teak and other lapacho woods (see 190).

Local races of teak and even individual trees vary greatly in desoxylapachol content (Hausen, 1970). It is interesting that Indonesian natives have long distinguished three grades of the wood, the poorest (djati semporna) being liable to cause skin irritation (Altona, 1924).

Forty-four patients with positive patch tests to teak have been seen at St John's (216).

Avicennia marina Vierhapper

Black mangrove, manglecito

This S. American tree used to be included in the Verbenaceae but is now placed in a separate family, the Avicenniaceae. The locally-used wood contains lapachol but there are no reports of toxic effects (Record & Hess, 1943).

189. *Vitex littoralis* A.Cunn.

Puriri, New Zealand teak

The splinters cause severe inflammation (Aston, 1923).

BIGNONIACEAE

190. *Tabebuia ipe* Standl.(T. *avellanedae* Lor. ex Griseb.)

Ipé (NP), ipê preto, lapacho,

pau d'arco, washiba,

ipê tabaco, tabakipe

Bethabara, Surinam greenheart

T. serratifolia Nichols.(T. *leucoxydon* Mart.,*Bignonia leucoxydon* L.)*T. guayacan* Hensl. et spp.

Guayacan

(T. *lapacho* K. Schum.)

The lapacho woods, formerly often called *Tecoma* spp., are characterized by the lapachol and

lapachonone they contain (Peckolt, 1873; Oesterle, 1913, 1916). Differentiation between the species is still difficult, and not to be relied on at all in earlier authors such as Matthes & Schreiber (1914) and Freise (1932, 1936). They are called ipê tabaco because their sawdust irritates the nose like snuff (Record & Mell, 1924). 'Lapacho . . . has one objection—its irritating dust, which is very fine and penetrates the nose, lungs and skin. In the hot summer months when shirts or aspirators are uncomfortable, penetration is quite painful. The pain is increased when one ventures into the sun. Effects last half an hour or so unless the dye is washed out with soap. During this process one's color changes from yellow-green to bright red' (Woolston & Phillips, 1955).

Freise (1932, 1936) saw eighty-three cases of illness and three deaths attributed to ipê in Brazil, but insufficient details are given to decide the cause of death. The fresh sawdust produced erythema and papules in a few hours, going on to severe weeping and crusting dermatitis which took several weeks to heal. Even old dry wood caused dermatitis after a few days' work. The dust was highly irritating to the throat and lungs, and often men complained of headache, drowsiness, weakness and cardiac irregularity; even impotence. The dust they swallowed caused only mild constipation but killed all their worms, an effect Freise attributed to the glycosides he found in the wood.

Cordero & Lynch (1951) reported a case of dermatitis with positive patch test in a man who had been sawing *T. avellanae*. Patch tests on four control subjects were negative. Weitbrecht (1967) described rhinitis and dermatitis of the face and hands in a man who cut, planed and polished bethabara wood for knife handles. It recurred when he worked with the wood again 4 years later. Bethabara is an American trade name for *Tabebuia* spp. used mainly for fishing rods (Record & Hess, 1943). Hausen (1970) identified Weitbrecht's wood as *T. serratifolia* and demonstrated lapachol and dextroxy-lapachol in it.

Like teak (188), the lapacho woods are known to contain small quantities of desoxy-lapachol (Dietrichs, 1964; Burnett & Thomson, 1967). It has been suggested that this is the main sensitizer, but patch tests with it on Weitbrecht's patient produced an apparent irritant reaction, only slightly stronger than in a control subject (Hausen *et al.*, 1971).

Tabebuia palmeri Rose

T. pentaphylla Hemsl.

Amapa prieta

Roble (NP), amapa

The sawdust of the Central American *T. palmeri* stains clothes and gives some workers mild dermatitis (Ortega, 1926; Burnett & Thomson, 1968). Ortega found no lapachol in *T. pentaphylla*, which Oliver (1908) wrongly thought to be the source of Maracaibo boxwood (Record & Mell, 1924; Frison, 1948).

191. *Paratecoma peroba* Kuhlman.

(*Tecoma peroba* Record)

White peroba, peroba jaune (NP),

p. de campos, p. grande,

p. amarella, p. branca,

ipê peroba, ipê branco

Paratecoma is much paler than the other lapacho woods (190) and was not placed in the Bignoniaceae until Record identified it in the twenties. Matthes & Schreiber (1914) had called it edelteak or moah and identified it as *Illipe* or *Bassia* (Record, 1925). Even in the thirties Touraine *et al.* (1932) and Freise (1937) were still calling it *Aspidosperma*.

Record & Mell (1924) noted that New York workmen considered the splinters poisonous.

Freise (1932) found that 'ipé branco' caused only transient cough when first used, but no skin irritation. Touraine *et al.* (1932) reported twenty cases of dermatitis in men sawing and sand-papering 'peroba grande amarella'. Erythema and itching on the arms, face, genitals and thighs sometimes went on to generalized weeping eczema. Transient yellow staining of the skin was seen in sunny weather. Touraine & Bernou (1932) examined various extracts of the wood, obtaining positive patch tests on controls as well as one patient, and thought an alkaloid was responsible.

Barnett (1948) described a smaller outbreak of dermatitis in England, but made no tests on the patients; two of eight controls gave positive patch tests. De Jong *et al.* (1951) reported five cases with positive patch tests both to sawdust and to lapachonone which they extracted from it. Although it is not widely used in England, the FPRL (1963) receives a good many trade reports of skin and mucosal irritation.

Besides lapachol and lapachonone, Sandermann *et al.* (1968) found several quinones in the wood.

192. *Tecoma radicans* Juss.

Trumpet vine

White (1903) thought *T. radicans*, like *Ampelopsis* spp., had probably been falsely accused of causing dermatitis where *Rhus* grew alongside it. No good evidence of toxicity has been found.

For other *Tecoma* spp. see *Tabebuia* (190).

193. *Jacaranda copaia* D. Don

Futui, gobaja (NP), parapara

J. coerulea Gris. et spp.

Caroba (NP), abbé blanc, boxwood

J. brasiliensis contains lapachol (Schulz, 1962) but no toxic effects have been reported. Hausen (1970) found a quinone in *Jacaranda* sp.

Sandermann & Barghoorn (1956) are not the only authors who have fallen into the trap of confusing *Jacaranda*, the scientific name of this genus of Bignoniaceae, with jacaranda, the popular name in Brazil of several *Dalbergia* and *Machaerium* species of the Leguminosae.

194. *Catalpa bignonioides* Walt.

Catalpa, Indian bean

There seems to be nothing against this tree except White's (1887) second-hand information that its 'emanations are reported to be poisonous' and its 'flowers irritant to many persons'. Smith (1920) and Weber (1930) list it, but give no indication that they have any better evidence.

NAUCLEACEAE

195. *Nauclea trillesii* Merrill

(*Sarcocephalus diderrichii* De Wild.)

N. latifolia Smith

Opepe, bilinga (NP), kussia,

badi, West African boxwood

African peach, country fig

Opepe was imported into England as African boxwood about 1900, and often confused with *Gonioma kamassi* (183). It is impossible now to tell how far opepe was responsible for the outbreak of toxic effects in shuttle-makers described under *Gonioma*.

Woodworkers at three factories in Ibadan, Nigeria, reported that opepe irritated their skin, producing crawl-crawl (dermatitis) in some men. Nasal irritation was also common, sometimes

accompanied by fever and headaches (Woods, 1964). The bark contains indolepyridine alkaloids and other bases (McLean & Murray, 1970).

The locally-used wood of *N. latifolia* is also suspect (Irvine, 1961).

Contact dermatitis from quinine, derived from the bark of the related *Cinchona*, was reported by White (1887) and by Burgess & Usher (1930).

196. *Mitragyna ciliata* Aubrev. & Pellerg.
M. stipulosa O.Ktze

Abura (NP), subaha, bahia,
elilom, vuku, African poplar

Partially seasoned abura has a pungent smell and some workers find the sawdust irritating (Titmuss, 1965). There are occasional trade complaints of dermatitis and nasal irritation in Nigeria (Wendorff, 1964; Woods, 1964) and in England (FPRL, 1963; Orsler, 1969). The sawdust was said to cause mucosal irritation and vomiting in East Germany (Wagenführ, 1961). Wilkinson has seen one case of dermatitis with positive patch test.

The wood of some *Mitragyna* species contains alkaloids (Denis, 1937, 1938; Irvine, 1961).

ST JOHN'S HOSPITAL CASES

Over a period of 20 years nearly 100 patients have been seen and proved to be allergic to one or more timbers at St John's Hospital for Diseases of the Skin. Most of them are sporadic cases which have been referred by their general practitioners, but some have been seen as a result of a specific request by an industrial physician to investigate an outbreak of industrial dermatitis.

Not all the patients have been investigated as fully as is desirable. In only a few have we been able to test them with the specific pure allergens now available for some timbers, and the individual timbers have not always been identified by scientific experts. In each case the patients are cross-referenced to the paragraph number used in the previous classification, inserted in brackets after the name of the timber.

197. *Afrormosia* (83)

In a furniture factory with an outbreak of dermatitis where afrormosia was being used, twenty men were tested with it and all were negative except one who gave a doubtful reaction (Case 1).

Case 1 (H11171). A 53-year-old joiner had suffered from attacks of dermatitis over 30 years. It affected his face, hands and arms, and was oedematous. He reacted to afrormosia, strongly to teak dust and to solvent extracts of teak. It appeared likely that teak was the main sensitizer. The reaction to afrormosia was much weaker. It was not repeated and may have been a false positive test in view of the very strong reaction to teak.

Case 2. A 52-year-old furniture worker had had dermatitis on and off for 7 years. He had been using maple, walnut, oak and mahogany for many years, but veneers of ayan, louro and afrormosia for about a year. Patch tests gave weak positive reactions to all three veneers, and they were probably not significant reactions in relation to his dermatitis.

198. *Agba* (101)

Two patients were allergic to agba. They both worked at the same factory but were seen at different times.

Case 3 (70916). A 64-year-old wood machinist gave a 5 week history of a dermatitis of his face and eyelids. Patch tests were positive to agba but negative to obeche, gurjun, beech, oak and mahogany. A year later he presented again with patches of nummular eczema which were thought to be unrelated.

Case 4 (73631). A 52-year-old wood machinist had an 18 month history of dermatitis of the face, eyelids, cubital and popliteal fossae. Patch tests were positive to agba and to ayan, but negative to obeche, oak, podo and guarea.

199. *Ayan (70)*

Twelve patients were sensitive to ayan wood. Eleven of them worked in a single furniture factory where the wood had recently been introduced as a veneer. The men had worked at the same factory for periods from 18 months to 16 years, and there had been little or no dermatitis in the factory until this epidemic.

Case 5 (13327). A 38-year-old cabinet-maker had dermatitis of the eyelids and backs of his hands. Patch tests were positive to ayan but negative to afrormosia, louro, maple, walnut, oak and mahogany.

Case 6 (K1373). A 43-year-old wood worker in a furniture factory handling veneers developed dermatitis of the face, eyelids and neck. Patch tests were weakly positive to ayan but negative to afrormosia and louro.

Case 7 (K347). A 36-year-old wood machinist had marked dermatitis of his face, eyelids, hands, arms and forearms. Patch tests showed a positive reaction to ayan, but negative to afrormosia and louro.

Case 8 (G6052). A 42-year-old wood machinist using veneers developed a rash under the chin which cleared when off work for a week. It recurred on his neck and arms 2 days after returning. He had a previous history of slight eczema on the front of his wrist. Patch tests were positive to ayan but negative to louro and afrormosia.

Case 9. A 55-year-old furniture worker had a month's history of mild dermatitis of the arms, legs and neck with irritation. Patch tests were weakly positive ($\pm$) at 96 h to ayan but negative to louro and afrormosia.

Case 10. A 63-year-old furniture worker had previously had dermatitis from teak over many years. For 3 months he had an itchy dermatitis of his elbow flexures. Patch tests were positive to ayan but not to louro or afrormosia.

Case 11. A 42-year-old furniture worker with hay fever had a month's history of dermatitis of the extensor aspect of his arms, and on the chin, cheeks and left calf. Patch tests were positive to ayan and weakly ($\pm$) to louro but negative to afrormosia.

Case 12. A 48-year-old furniture worker had dermatitis of the forehead, eyelids and arms. Patch tests were positive to ayan but negative to louro and afrormosia.

Case 13. A 52-year-old veneer press operator had had dermatitis of his hands on and off for 7 years. He had been away from work for 7 weeks but the rash had not cleared. He showed a papular dermatitis of the flexor forearms, some swelling around the mouth, and a chronic red fissured and thickened dermatitis of the hands. He handled urea-formaldehyde resin glues as well as the veneers. Patch tests showed weakly positive ($\pm$) reactions to afrormosia, ayan and louro, which were regarded as of doubtful relevance to his dermatitis.

Case 14. A 42-year-old foreman furniture worker had dermatitis of his forehead and around the mouth. Patch tests were positive to ayan (+ +) but negative to louro and afrormosia.

Case 15. A 40-year-old furniture worker had dermatitis of his face, neck and front of the wrists, and also round the mouth. Patch tests were positive to ayan but negative to louro and afrormosia.

Case 16 (K11888). A 49-year-old wood machinist had a 3 month history of dermatitis of the fingerwebs, hands and forearms, face, neck, thighs and genitalia. He gave positive patch test reactions to ayan, teak dust and solvent extracts of teak.

Case 2. See para. 197 Afrormosia.

Case 4. See para. 198 Agba.

TABLE 1. Patch test results with three veneers in a furniture factory

Wood	Positive	Doubtful ($\pm$)	Negative	Total
Afrormosia	0	1	21	22
Ayan	8	3	11	22
Louro	2	3	17	22

The epidemic of dermatitis from ayan was investigated at a furniture factory in 1962 and 1963. Most of the furniture was covered with one of several veneers. The woods used for many years were maple, walnut, oak and mahogany. Veneers of louro and afrormosia were introduced in 1961 and ayan in about January 1962. The first case of dermatitis occurred in April 1962, and eventually more than twenty men complained of skin trouble. Some of them worked on the veneer presses using a urea-formaldehyde resin glue as adhesive.

Twenty-two of the men were examined and patch tested to the three veneers. With ayan, eight were positive, three gave weak ($\pm$) reactions and eleven were negative. With louro, two were positive, three doubtful and seventeen negative. Eight men were negative to all three veneers (Table 1). Unfortunately none of these was tested with formaldehyde resin or the other woods.

The cause of the negative reactions in these men is not known. They were thought to be irritant effects or non-associated dermatitis. Most of the cases of dermatitis in the factory occurred at a time of very cold weather when windows were closed, heating of the factory increased and the dust extraction was defective. The men were also wearing warmer clothing and sweating more.

200. *Birch* (23)

Case 17 (M66849). A 46-year-old cabinet maker had a 2 month history of dermatitis of the eyelids, neck, chest, elbow flexures, axillae and groins. Patch tests were positive to teak, deal, Swedish birch, lapachol and anthothecol, but negative to mahogany, beech and wood and coal tars.

201. *Blackwood, African* (94)

Two patients were allergic to African blackwood (*Dalbergia melanoxylon*) and both of them were employed on making clarinets by a musical instrument firm.

Case 18 (G3498). A 67-year-old musical instrument maker had had recurrent attacks of dermatitis of his face, forehead and elbow flexures. Patch tests were strongly positive to African blackwood and to teak dust. He later presented with a severe dermatitis of the face associated with the use of a germicidal soap and was patch test positive to tetrachlorsalicylanilide.

Case 19 (81147). A 65-year-old wood machinist had been making clarinets with African blackwood for 6 months. He gave a 3 week history of dermatitis of the front of his wrists and elbow flexures. His face and hands were unaffected. He stated that three other men at the same musical instrument factory were affected. A patch test with African blackwood was positive.

202. *Cedar* (13)

Two cases of contact dermatitis from cedar wood in pencils have already been reported by Calnan (1972).

Case 20 (A9405). A 23-year-old joiner had a 3 month history of dermatitis of the face, neck and arms. The clinical appearances had some features suggesting discoid and others suggesting atopic eczema. Patch tests were positive to oak and cedar woods and showed an irritant reaction to teak dust, but were negative to mansonina, walnut, mahogany, utile and sapele.

203. *Gaboon* (111)

Case 21 (93521). A 53-year-old joiner gave a history of three attacks of dermatitis over a period of 18 months. It affected his eyelids, backs of his hands, and forearms. Patch tests were positive to gaboon and deal (pine or possibly spruce) but negative to 'African rantang'.

204. *Iroko* (32)

Case 22 (A3323). A 22-year-old wood machinist complained of generalized itching especially at night for 8 months. It was worse on his body, arms and scrotum. Patch tests were positive to iroko wood and to teak, but negative to obeche and pine.

Case 23 (M79257). A 15-year-old boy training to be a carpenter had a 4 month history of dermatitis of his arms and eyelids. Patch tests were positive to iroko wood and to colophony but not to wood or coal tars.

205. *Laurel, Indian (159)*

Case 24 (M85588). A 46-year-old man worked as a veneer preparer. He developed an extensive dermatitis of the face, head and neck, which spread to the trunk and limbs. His eyelids had been swollen. He gave positive patch tests to Indian laurel, teak, Honduras mahogany, jacaranda rosewood and primula; doubtful ($\pm$) reactions to ash, pine and elm; and was negative to makoré, African walnut, and to wood and coal tars. He was positive to R- and S-dalbergione but negative to lapachol, pinosylvin and anthothecol.

206. *Louro (44)*

Five men reacted to louro when using it as a veneer in a furniture factory. Two were definite and three were doubtful reactions. Seventeen other men with dermatitis who were tested gave negative reactions.

Case 25 (K348). A 40-year-old wood machinist had a recent history of dermatitis of the face and arms. Patch tests were positive to louro, but negative to ayan and afrormosia.

Case 26 (K1552). A 52-year-old furniture worker had psoriasis and angioma serpiginosum. For 2 weeks he had a dry scaly dermatitis of the face and neck. Patch tests were positive to louro, but negative to ayan and afrormosia.

Case 27. A 30-year-old furniture worker gave a 2 month history of dermatitis of his forehead and the dorsa of his hands. Patch tests were weakly positive ($\pm$) to louro and negative to ayan and afrormosia.

Case 11. See para. 199 Ayan.

Case 13. See para. 199 Ayan.

207. *Mahogany, Honduras (113)*

Case 24 (M85588). See para. 205 Laurel.

208. *Mansonia (147)*

Four patients were positive to mansonia, which was imported in large quantities between 1945 and 1955. One was a female cleaner who only swept up sawdust and had dermatitis of the feet, while the three men were a joiner, a cabinet-maker and a sawmill grinder.

Case 28 (F10722). A 63-year-old joiner gave a 3 month history of dermatitis of the face, eyelids, scalp, arms and axillae. Patch tests were positive to mansonia and to teak.

Case 29 (C12170). A 58-year-old grinder in a sawmill had a long-standing leg ulcer and a more recent dermatitis of the face. Patch tests were positive to mansonia, sapele and teak ($\pm$), but negative to obeche, ebony, agba, abura, mahogany, Japanese oak, blackwood and walnut.

Case 30 (C12714). A 58-year-old female cleaner in a school had a dermatitis of the hands which was thought to be due to alkali and detergents. She also had dermatitis of the feet which she said was due to sweeping up sawdust in the carpentry room at the school. Patch tests were

positive to mansonia, but negative to teak, agba, abura, obeche, ebony, walnut, mahogany, sapele and boxwood.

Case 31 (C13590). A 54-year-old cabinet-maker had dermatitis of his face and wrists. Patch tests were positive to mansonia and rosewood, but negative to makoré, ash, mahogany and teak.

209. *Oak (24)*

Case 32 (H9198). A 48-year-old woodworker had extensive atopic dermatitis. Patch tests were positive to teak and oak.

Case 33 (H9647). A 40-year-old housewife had a dermatitis which was thought to be due to the wearing of textiles. Patch tests were positive to formalin and to oak.

Case 20 (A9405). See para. 202 Cedar.

210. *Pine, Deal (7)*

Case 34 (M33170). A 33-year-old carpenter worked mainly on the erection of display stands for exhibitions. He handled many primary irritants. He gave a 6 month history of dermatitis of both palms. Patch tests were positive to Norwegian red deal but negative to teak and utile.

Case 35 (M78794). A 43-year-old carpenter had a 10 year history of recurrent dermatitis of the face, eyelids, ears, neck, hands and scrotum. Patch tests were positive to teak, pine, phenol formaldehyde and lapachol, but negative to dalbergione, pinosylvin, anthothocol, and to wood and coal tars.

Case 36 (M93323). A 16-year-old carpenter apprentice had a 1 year history of dermatitis of the palms and fingers, face, eyelids, and around the mouth. It cleared when he was away from work. Patch tests were positive to deal (+ +), pinosylvin, anthothocol, colophony, formalin and turpentine, but negative to dalbergione, pinomonosylvin monomethyl ether, wood and coal tars.

Case 21 (93521). See para. 203 Gaboon.

Case 37 (M8733). A 55-year-old cabinet maker had an oedematous dermatitis for a month of his face and elbow flexures. Patch tests were positive to Portuguese pine and hardboard, but negative to gaboon, mahogany, teak and oak.

Case 17. See para. 200 Birch.

211. *Pine, Parana (3)*

Case 38 (M91544). A 64-year-old carpenter had had attacks of dermatitis over a period of 5 years, affecting his eyelids, hands and legs. He had used an epoxy resin adhesive on some wood. Patch tests were positive to ramin, parana pine and teak, as well as to epoxy resin and to wood and coal tars. It was not possible to be certain that his samples of wood were not contaminated with cured resin but we think this unlikely.

212. *Ramin* (157)

Case 38 (M91544). See above Parana Pine.

213. *Rosewood* (94)

Eight patients were sensitive to rosewood (*Dalbergia* spp.), seven men and one woman. Their ages ranged from 46 to 60 years at the time of presentation. Their occupations were musical instrument maker, wood machinist (2), cabinet-maker (2), timber yard foreman, veneer preparer and housewife. Three had involvement of the genitalia or groins, and one had cheilitis from holding wood in his mouth.

Case 39 (F14226). A 43-year-old man who was a clarinet player, worked on making musical instruments using a lot of rosewood. For 15 years he had had recurrent attacks of dermatitis of his eyelids, lips, face, neck, elbow flexure and of the genitalia. Patch tests were positive to rosewood, but negative to primula leaf, colophony and formalin.

Case 40 (E10462). A 59-year-old cabinet maker had a 9 week history of dermatitis of his neck, scalp, face, arms and chest. Patch tests were positive to wood dust from his workshop, rosewood and utile, but negative to walnut, ramin, oak, pine and mahogany.

Case 41 (G11982). A 59-year-old wood machinist gave a week's history of dermatitis of his face, neck and wrists. Patch tests were positive to rosewood and teak, but he was negative to afrormosia, mahogany and meranti.

Case 31 (C13590). See para. 208 *Mansonia*.

Case 42 (M26610). A 58-year-old timber foreman gave a 2 year history of dermatitis of his face, eyelids, hands, arms and groins. He had noted that holding a piece of rosewood in his lips resulted in acute dermatitis. Patch tests were positive to rosewood and teak, wood tars, coal tars, balsam of Peru, chromate and paraphenylenediamine. He was negative to primula, colophony and turpentine. Tests with wood allergens gave positive reactions to pinosylvine, anthothecol, R- and S-dalbergione, and lapachol. This man was so sensitive to rosewood that some of these reactions may have been false positives.

Case 43 (M45787). A 60-year-old housewife had worked with rosewood. In the past year she had had three attacks of dermatitis of her legs, arms and cubital fossae, accompanied by sneezing. Patch tests were positive to rosewood, but negative to beech, primula, wood and coal tars, colophony, turpentine and balsam of Peru.

Case 44 (H11491). A 49-year-old wood machinist had attacks of dermatitis of the face, eyelids, axillae, elbow flexures and genitalia. Patch tests were positive to rosewood but negative to makoré and teak.

Case 24 (M85588). See para. 205 *Laurel*.

The patch test results show that all eight patients reacted to rosewood dust. Additional woods reacting in these patients were utile (1), Honduras mahogany (1), Indian laurel (1), mansonia (1) and teak (2). Only two of the patients could be tested to the wood allergens; both were positive to dalbergione (0.1% in petrolatum), the allergen in rosewood. The patient (Case

45) who also reacted to teak was positive to lapachol, pinosylvin and anthothocol, but these reactions could have been false positives. They were not repeated later. However, *Dalbergia nigra* (Brazilian rosewood, jacaranda) belongs to the family *Leguminosae* and is not related to *Jacaranda* spp. which are known to contain lapachol. There is, therefore, no evidence of cross-reaction between woods in our patients, and the multiple sensitivities are likely to be separately acquired allergies.

Not all the cases were tested to a standard series of contact allergens, but three patients were negative to primula, colophony and turpentine. One was positive and one negative to wood and coal tars and balsam of Peru.

A possible allergenic relationship between rosewood and primula was suggested by Hjorth (1965) and by Wilkinson (personal communication, 1970) who found some rosewood-sensitive patients positive to primula.

214. *Sapele* (115)

Case 45 (M34971). A 57-year-old wood machinist had had three attacks of dermatitis and swelling of his eyelids in a month. It spread to involve his face, neck, scalp, elbow flexures, groins, popliteal spaces and feet. Patch tests were weakly positive to sapele but negative to the European standard series, to obeche and African mahogany.

Case 29 (C12170). See para. 208 *Mansonia*.

215. *Spruce* (4)

Case 46 (86216). A 30-year-old musical instrument maker had a previous history of infantile eczema and of dermatitis from a watch. For 9 months he had dermatitis of the back of his hand and the skin of the thumb and index finger web. Patch tests were positive to spruce and to casein glue.

216. *Teak* (188)

Case 47 (E5972). A 47-year-old wood machinist had a 10 year history of dermatitis of the face, neck and eyelids. Patch tests were positive to teak but negative to abura, boxwood, obeche, mansonia, beech and walnut.

Case 48 (E3965). A 52-year-old joiner had recurrent dermatitis of the face, eyelids, arms and genitalia for 3 years. A patch test was positive to teak dust.

Case 49 (D516). A 51-year-old wood machinist had had attacks of dermatitis of the face, neck and dorsa of his hands over 4 years. Patch tests were positive to teak dust and to a petroleum ether extract of it but negative to alcohol and aqueous extracts. He was also negative to oak, walnut, mahogany, ramin, obeche, agba and rosewood.

Case 50 (H2735). A 57-year-old joinery labourer with dermatitis had a positive patch test to teak dust and to solvent extracts, but was negative to mansonia and iroko.

Case 51 (B12350). A 53-year-old carpenter had a 6 week history of dermatitis of the face, forearm and scrotum. Patch tests were positive to teak dust but not to solvent extracts of it.

Case 52 (G11982). A joiner gave a history of dermatitis of the eyelids, face, beard area, wrists and hands. Patch tests were positive to teak dust and a petroleum ether extract but negative to alcoholic and aqueous extracts.

Case 53 (G5859). A 47-year-old wood machinist had a 2 month history of dermatitis of the wrists, palms and dorsa of the hands. A patch test with teak dust was strongly positive.

Case 54 (G3498). A joiner stated that he had had dermatitis from teak some years before a recent relapse. Patch tests were positive to teak dust but negative to obeche, beech, pine and iroko.

Case 55 (G3099). A 55-year-old musical instrument maker had a dermatitis of the face, ears, and penis for 6 years. A patch test to teak dust was positive.

Case 56 (G1620). A 58-year-old wood machinist first developed dermatitis from teak 25 years before he presented with an acute attack affecting the face, eyes, hands and arms. A patch test was positive to teak, but negative to abura, sapele, oak and utile.

Case 57 (F5836). A 53-year-old joiner gave a 7 year history of dermatitis of the eyelids, face, beard area, wrists and hands. Patch tests were positive to teak dust and a petroleum ether extract but negative to alcoholic and aqueous extracts.

Case 58 (A7383). A 70-year-old joiner stated that he had had dermatitis from teak 33 years before a recent relapse. Patch tests were positive to teak dust but negative to obeche, beech, pine and iroko.

Case 59 (A3024). A 25-year-old carpenter had five attacks in a month of swelling of his eyelids. Patch tests were positive to teak dust but negative to spruce, pine and obeche.

Case 60 (A3323). A cabinet-maker had a 10 week history of dermatitis of his right forearm, face and ankles. Patch tests were positive to teak but negative to mahogany, pine and cedar.

Case 61 (A4683). A 24-year-old carpenter had a 3 month history of dermatitis of the knee and elbow flexures, later spreading to the hands. Patch tests were positive to teak but negative to oak, spruce and keruing.

Case 62 (C12170). A 58-year-old sawmill grinder had a chronic leg ulcer and a more recent dermatitis of the face. Patch tests were weakly positive to teak dust, positive to mansonia and sapele, but negative to obeche, ebony, agba, abura, mahogany, Japanese oak, blackwood and walnut.

Case 63 (M35286). A 50-year-old butcher had an attack of dermatitis of the hands at the age of 34 years and a recurrence at the age of 49 years. He presented with a recent thickened eczema of the palms. During his work he handled sawdust and did woodwork as a hobby. Patch tests were positive to teak, sawdust from the butcher's shop, balsam of Peru, wool alcohols and tetramethylthiuram disulphide.

Case 64 (M34971). A 57-year-old wood machinist over a period of a month had three attacks of swelling of the eyelids. It later spread to the face, scalp, neck, elbow flexures, groins, popliteal spaces and feet. Patch tests were positive to teak (possibly irritant) and sapele ($\pm$), but negative to balsam of Peru, colophony, wood tars, African mahogany and obeche.

Case 65 (M34389). A 36-year-old cabinet maker had a 10 week history of dermatitis of his right forearm, face and ankles. Patch tests were positive to teak but negative to mahogany, pine and cedar.

Case 66 (M32774). A 20-year-old carpenter complained of dermatitis of his neck and shoulders over a period of 8 years. Patch tests were positive to teak dust and weakly ($\pm$) to solvent extracts of it, but negative to deal, mahogany and oak.

Case 67 (M33605). A 44-year-old carpenter gave a 1 year history of dermatitis of his hands, wrists, fingers and eyelids. A patch test was strongly positive to teak.

Case 68 (M69261). A 59-year-old wood machinist first had dermatitis from teak some 40 years ago and again 10 years ago. One year ago he had handled teak again with a further recurrence on the hands, arms and legs. He had used a lanolin-containing barrier cream which made the dermatitis worse. Patch tests were positive to teak, wool alcohols, wood and coal tars and Vioform, but negative to lapachol, afrormosia, ash, deal and oak.

Case 69 (M18043). A 63-year-old wood machinist had had two attacks of dermatitis from teak 12 and 6 years ago. One year ago he developed a dermatitis on his legs, arms and face after using teak again. He had a chronic stasis dermatitis. Patch tests were strongly positive to teak and lapachol, and to wood and coal tars.

Case 70 (G1077). A 55-year-old engineer developed a dermatitis of 'seborrhoeic' pattern on the chest, in the groins, axillae and cubital flexures. A patch test was positive to teak dust.

Case 71 (M38417). A 57-year-old carpenter had a 2 week history of dermatitis of the arms, face and genitalia soon after he started working with teak. Patch tests were positive to teak, but negative to oak, mahogany, walnut, deal and pine, as well as to colophony, turpentine and balsam of Peru.

Case 72 (M61466). A 61-year-old painter had been rubbing down some teak wood with sandpaper. Within 4 h his eyelids were swollen and he later developed dermatitis of the face, hands and forearms. Patch tests were positive to teak dust, solvent extracts of it and lapachol and to anthothecol; he was negative to pinosylvine, dalbergione, turpentine and balsam of Peru.

Case 73 (M60100). A 41-year-old wood machinist had had dermatitis of his face, scalp and fingers some 20 years earlier. One year ago he developed a dermatitis of the arms, body, legs, feet, axillae and genitalia. Patch tests were positive to a chipboard, colophony, teak ($\pm$) and wood tars ($\pm$), but negative to walnut, sapele, lapachol, anthothecol, dalbergione, pinosylvine, formalin and coal tars.

Case 74 (M53957). A 53-year-old carpenter had a month's history of dermatitis of the face

and scalp which spread to the arms and thighs. Patch tests were strongly positive to teak dust and to lapachol, but negative to keruing, dalbergione, anthothecol, pinosylvine and wood and coal tars.

Case 75 (92067). A 40-year-old joiner had an 18 month history of dermatitis of the face, chin and eyebrows which he said was aggravated by wood dust. Patch tests were positive to teak but negative to oak, Japanese oak, mahogany and abura.

Case 76 (H9462). A 61-year-old man had had recurrent attacks of dermatitis over 30 years. Patch tests were positive to teak dust and to solvent extracts of it.

Case 77 (H9198). A 48-year-old woodworker had a history of 'atopic dermatitis'. Patch tests were positive to teak and oak.

Case 78 (K1321). A 42-year-old labourer in a wood mill gave a 3 month history of dermatitis of the face, arms, chest and thighs. Patch tests were positive to Burma teak dust and to an ether extract but negative to a chloroform extract of it. Tests were also negative to oak, mahogany, rosewood and obeche.

Case 79 (K2016). A 59-year-old wood machinist had a 3 month history of dermatitis of the hands. Patch tests were positive to teak but negative to sapele and afrormosia.

Case 80 (K9513). A 28-year-old carpenter, making kitchen cabinets and other fittings, had a dermatitis of the face, groins and hands with a lot of oedema. Patch tests were positive to teak dust and to solvent extracts of it.

Case 1 (H11171). See para. 197 Afrormosia.

Case 16 (K11888). See para. 199 Ayan.

Case 17 (M66849). See para. 200 Birch.

Case 18 (G3498). See para. 201 Blackwood.

Case 20 (A9405). See para. 202 Cedar.

Case 22 (A3323). See para. 204 Iroko.

Case 24 (M85588). See para. 205 Laurel.

Case 28 (F10722). See para. 208 Mansonia.

Case 29 (C12170). See para. 208 Mansonia.

Case 32 (H9198). See para. 209 Oak.

Case 35 (M78794). See para. 210 Pine.

Case 38 (M91544). See para. 211 Parana Pine.

Case 41 (G11982). See para. 213 Rosewood.

Case 42 (M26610). See para. 213 Rosewood.

Case 82 (M79021). See para. 219 Walnut.

217. *Utile* (115)

Case 43 (E10462). See para. 213 Rosewood.

218. *Walnut, African* (116)

Case 81 (H8065). A 40-year-old man worked in a wood machining factory. One month after starting he developed a rash on all exposed areas; it improved on stopping work but recurred on returning. Patch tests were positive to African walnut, but negative to African mahogany, red beech and American beech.

219. *Walnut* (21)

Case 82 (M79021). A 43-year-old cabinet-maker gave an 8 month history of an extensive dermatitis of the hands, arms and sides of the neck. He had been receiving treatment for 3 years with systemic steroids for an illness considered to be polyarteritis nodosa with pulmonary involvement.

He used veneers of walnut, avodiré and teak. Scratch tests were negative. Patch tests were positive to paraphenylenediamine, primula, mercaptobenzthiazole, vioform, wood and coal tars, walnut, teak and avodiré. Later patch tests were positive to his own walnut, teak and avodiré veneers, as well as to lapachol and anthothecol. The veneers were identified by the Forest Products Research Laboratory as walnut (*Juglans regia*), teak (*Tectona grandis*) and avodiré *Turraeanthus africanus*). He changed his occupation and made a complete recovery from the dermatitis.

220. *Avodiré* (118)

Case 82 (M79021). See para. 219 Walnut.

PRINCIPAL TOXIC TIMBERS

Trade name	Botanical name	Dermatitis, Mucosal irritation, Asthma, General symptoms	Active substances	Para.
Arbor vitae	<i>Thuja standishii</i>	M A	Tropolones	13
Ayan	<i>Distemonanthus benthamianus</i>	D	Oxyanilins	70
Blackwood, African	<i>Dalbergia melanoxylon</i>	D	Dalbergiones	94
Boxwood, Knysna	<i>Gonioma kamassi</i>	M A G	Quebrachamine ?	183
Cedar, Western red	<i>Thuja plicata</i>	(D) M A	Tropolones	13
Cocobolo	<i>Dalbergia retusa</i> et spp.	D	Dalbergiones	94
Cocus	<i>Brya ebenus</i>	D	Quinones ?	91
Dahoma	<i>Piptadeniastrum africanum</i>	M	?	62
Ebony	<i>Diospyros</i> spp.	D M	Quinones	173
Guarea	<i>Guarea thompsonii</i> et spp.	M	?	117
Ipé (lapacho)	<i>Tabebuia ipe</i> et spp.	D M G	Desoxylapachol	190
Iroko	<i>Chlorophora excelsa</i>	D (M A)	Stilbene	32
Katon	<i>Sandoricum indicum</i>	M G	?	120
Mahogany, African	<i>Khaya ivorensis</i> et spp.	D (M)	Anthothecol	114
Mahogany, American	<i>Swietenia macrophylla</i> et spp.	D	?	113
Makoré	<i>Tieghemella heckelii</i>	D M	Saponin	170
Mansonia	<i>Mansonia altissima</i>	(D) M G	Mansonones (quinones) Glycosides	147
Obeche	<i>Triplochiton scleroxylon</i>	(D) M A	?	146
Opepe	<i>Nauclea trillesii</i>	D M	?	195
Peroba rosa	<i>Aspidosperma peroba</i>	D M G	Alkaloids	179
Peroba, white	<i>Paratecoma peroba</i>	D M	Desoxylapachol ?	191
Ramin	<i>Gonystylus bancanus</i>	D	?	157
Rosewoods	<i>Dalbergia</i> spp., <i>Machaerium</i> spp.	D	Dalbergiones	94
Satinwood, Ceylon	<i>Chloroxylon swietenia</i>	D	Alkaloid ? Furocoumarins ?	108
Satinwood, W. Indian (and African)	<i>Fagara flava</i> et spp.	D	Alkaloid ? Furocoumarins ?	103
Sequoia	<i>Sequoia sempervirens</i>	M G	?	10
Stavewood	<i>Dysoxylum muelleri</i>	M G	?	119
Teak	<i>Tectona grandis</i>	D	Desoxylapachol	188
Liverworts and lichens on bark	<i>Frullania</i> , etc.	D	Sesquiterpene lactones	24

U.K. HARDWOOD IMPORTS (1969)

Separate figures are available only for the species listed (Davis, 1970). Softwoods are imported in much larger quantities but no specific figures are given for toxic ones like *Thuja* spp.

	Thousands of cubic feet	
	Lumber	Logs
Beech	6172	Unspec.
Keruing	2788	Unspec.
Ramin	2211	Unspec.
Utile	2163	1149
Birch	1942	Unspec.
Oak	1021	Unspec.
Obeche	923	1236
Mahogany	646	2088
Teak	495	Unspec.
Okoumé	Unspec.	134
Abura	Unspec.	862
Poplar	Unspec.	382
Unspecified	8271	4543

REFERENCES

- ACHESON, E.D. (1967) Hodgkin's disease in woodworkers. *Lancet*, **ii**, 988.
- ACHESON, E.D., COWDELL, R.H., HADFIELD, E. & MACBETH, R.G. (1968) Nasal cancer in woodworkers in the furniture industry. *British Medical Journal*, **ii**, 587.
- ALDERSLEY, R.B. (1925) Sensitiveness to proteins of wood. *Medical Journal of Australia*, **2**, 25.
- ALEMANY-VALL, R. (1958) Rhinitis and dermatitis caused by exotic woods. In: *Occupational Allergy*, p. 273, Stenfort-Kroeze. Leiden.
- ALLEN, P.H. (1943) Poisonous and injurious plants of Panama. *American Journal of Tropical Medicine* (suppl.), **23**, 1.
- ALTONA, T. (1924) Djati en Hindoes. *Tectona*, **17**, 865.
- ANDERSON, A.B. & ZAVARIN, E. (1955) *Journal of the Institute of Wood Science*, **15**, 3.
- ANON. (1906) Poisonous Wood. *Timber Trades Journal*, **60**, 860.
- ANON. (1923) Results of the examination of Nigerian timbers. *Bulletin of the Imperial Institute*, **21**, 444.
- ANON. (1933) Erkrankungen bei Benutzung von Cocobolo-Blockflöten. *Collegium musicum (Bärenreiter)*, **1**, 13.
- ANON. (1955) Douka. *Bois et Forêts des Tropiques*, **42**, 37.
- ANON. (1957) Wood dust and the woodworker. *Timber Technology*, **65**, 205.
- ARNOLD, H.L. (1942) Dermatitis due to the blossom of *Grevillea banksii*. *Archives of Dermatology and Syphilology*, **45**, 1037.
- ARONOW, L. & KERDEL-VEGAS, F. (1965) Seleno-cystathionine, a pharmacologically active factor in the seeds of *Lecythis ollaria*. *Nature*, **205**, 1185.
- ASAKAWA, Y., BENEZRA, C., DUCOMBS, G., FOUSSEREAU, J., MULLER, J.C. & OURISSON, G. (1974) Cross-sensitization between *Frullania* and *Laurus nobilis*. *Archives of Dermatology*, **110**, 957.
- ASTON, B.C. (1923) The poisonous, suspected and medicinal plants of New Zealand. *New Zealand Journal of Agriculture*, **26**, 78 & 149.
- AULD, S.J.M. (1909) An examination of irritant woods. 1. Chloroxylonine from E. Indian Satinwood. *Journal of the Chemical Society*, **95**, 964.
- AULD, S.J.M. & PICKLES, S.S. (1912) The constituents of W. Indian Satinwood. *Journal of the Chemical Society*, **101**, 1052.
- AVILA, R. (1972) Some aspects of suberosis. *Les Bronches (Paris)*, **22**, 121.
- BAHN, K. (1928) Beitrag zur Frage der Allergie bei Holzsägereiarbeitern. *Klinische Wochenschrift*, **7**, 1963.
- BAKER, R.T. (1919) *The Hardwoods of Australia*. Govt. State N.S.W., Australia.
- BARHAM, H. (1794) *Hortus americanus*. Kingston, Jamaica.
- BARNETT, G.P. (1948) *Report of the Chief Inspector of Factories*, p. 94. HMSO, London.
- BARNISKE, R. (1957) Dermatitis bullosa ausgelöst durch den Saft grüner Walnussfruchtschalen (*Juglans regia*). *Dermatologische Wochenschrift*, **135**, 189.
- BARROSO, C. (1947) Dermatite eczematosa de tipo dermocontacto provocada pela serragem de caviúna (*Dalbergia nigra*). *O Hospital (Rio)*, **31**, 291.
- BASSEWITZ, E. VON (1928) Die südbrasilianische Arocirkrankheit. *Archiv für Schiffs- und Tropen-hygiene*, **32**, 494.
- BATEMAN, T. (1819) *A Practical Synopsis of Cutaneous Diseases*, 5th edn, p. 257. Longman, London.
- BAUMER, M. (1955) Que faut-il croire de la toxicité de certains bois tropicaux? *Bois et Forêts des Tropiques*, **43**, 27.
- BEHL, P.N. & CAPTAIN, R.M. (1966) *Skin-irritant and Sensitizing Plants found in India*. Behl, New Delhi.
- BEHRBOHM, P. (1957) Allergisches Kontakt-Ekzem durch chromathaltige Holzschutzmittel. *Berufsdermatosen*, **5**, 271.
- BERLIN, C. (1930) Feigenbaumdermatitis. *Dermatologische Wochenschrift*, **90**, 733.
- BERNHARD-SMITH, A. (1923) *Poisonous Plants of all Countries*, 2nd edn. Baillière Tindall, London.
- BEVAN, C.W.L. (1958) Wood extractives. *West African Journal of Biological Chemistry*, **2**, 36.
- BIDIE, G. (1905) Satinwoods and dermatitis. *British Medical Journal*, **i**, 74.
- BISSET, I.J.W. (1949) Irritant properties of Miva mahogany. *Forest Products News Letter*, no. 178, p. 3.
- BLACK, A., EVANS, J.C., HADFIELD, E.H., MACBETH, R.G., MORGAN, A., & WALSH, M. (1974) Impairment of nasal mucociliary clearance in woodworkers in the furniture industry. *British Journal of Industrial Medicine*, **31**, 10.

- BLEUMINK, E., MITCHELL, J.C. & NATER, J.P. (1973) Allergic contact dermatitis from cedar wood (*Thuja plicata*). *British Journal of Dermatology*, **88**, 499.
- BLOHM, H. (1962) *Poisonous Plants of Venezuela*. Wissenschaftliche, Stuttgart.
- BODEAU (1936) A propos de quelques accidents dus au mancenillier. *Archives de Médecine et Pharmacie Navales*, **126**, 122.
- BOLUS, M. (1939) Dermatitis venenata due to Ginkgo berries. *Archives of Dermatology and Syphilology*, **39**, 530.
- BOULGER, G.S. (1906/7) *Familiar Trees*. Cassell, London.
- BOULGER, G.S. (1908) *Wood*, 2nd edn. Arnold, London.
- BOURNE, L.B. (1956) Dermatitis from Mansonia wood. *British Journal of Industrial Medicine*, **13**, 55.
- BOUSSINGAULT & RIVERO (1825) Mémoire sur le lait vénéneux de l'hura crepitans. *Annales de chimie et de physique*, **28**, 430.
- BOWEN, R. (1939) Karaya gum as a cause of urticaria. *Archives of Dermatology and Syphilology*, **39**, 506.
- BREZINA, E. (1921) *Internationale Übersicht über Gewerbekrankheiten über des Jahr 1913* (Ed. by L. Teleky and E. Brezina). Springer, Berlin.
- BRIDGE, J.C. (1935, 1937) *Reports of the Chief Inspector of Factories and Workshops*, London.
- BRIGGS, L.H. (1946) Plant products of New Zealand. *Journal of the Proceedings of the Royal Society of New South Wales*, **80**, 151.
- BRISSEMORE & COMBES (1905) Sur le juglon. *Comptes rendus de l'Académie des Sciences*, **141**, 838.
- BROERS, H. (1926) Dermatitis venenata. In: *Die Schädigungen der Haut durch Beruf und gewerbliche Arbeit* (Ed. by K. Ullmann, J.H. Rille and M. Oppenheim). Voss, Leipzig.
- BRÜGEL, S. & PERUTZ, A. (1927) Über Klinik und Pathogene der Erlenholzdermatitis. *Archiv für Dermatologie und Syphilis*, **153**, 661.
- BUHR, A.J. (1960) The thorn in the flesh. *Lancet*, **i**, 309.
- BULLETIN (1935) Bulletin de l'Union internationale des Ouvriers du Bois 1931-2. Les Maladies professionnelles dans l'Industrie du Bois. *Annales d'Hygiène publique*, **13**, 139.
- BURGESS, J.F. & USHER, B. (1930) On hypersensitiveness to quinine. *Canadian Medical Association Journal*, **23**, 45.
- BURKILL, I.H. (1935) *A Dictionary of the Economic Products of the Malay Peninsula*. Crown Agents, London.
- BURN, R.S. (n.d.) *The New Guide to Carpentry*. Fullarton, London. (c. 1870).
- BURNETT, A.R. & THOMSON, R.H. (1967) The Quinonoid Constituents of *Tabebuia avellanedae* (Bignoniaceae). *Journal of the Chemical Society (C)*, 2100.
- BURNETT, A.R. & THOMSON, R.H. (1968) Extractives from *Tabebuia chrysantha* Nichols. and other Bignoniaceae. *Journal of the Chemical Society (C)*, 850.
- BUSCHKE, A. & JOSEPH, A. (1927) Ueber Hautentzündung hervorgerufen durch Makassarholz. *Deutsche medizinische Wochenschrift*, **53**, 1641.
- CALNAN, C.D. (1972) Dermatitis from Cedar wood pencils. *Transactions of the St John's Hospital Dermatological Society*, **58**, 43.
- CALNAN, C.D. & SHUSTER, S. (1963) Reactions to ammonium persulfate. *Archives of Dermatology*, **88**, 812.
- CANCELLA, L. DE C. (1955) On a special kind of pneumoconiosis: the suberosis. *A Medicina contemporânea (Lisbon)*, **73**, 235.
- CANCELLA, L. DE C. (1963) Suberosis: a pneumoconiosis due to cork dust—the present stage of the problem. *Industrial Medicine and Surgery*, **32**, 435.
- CASH, J.T. (1911) The dermatitis produced by E. Indian satinwood (*Chloroxylon swietenia*). *British Medical Journal*, **ii**, 784.
- CHALK, L., CHATTAWAY, M.M., BURTT DAVY, J., LAUGHTON, F.S. & SCOTT, M.H. (1935) *Fifteen S. African High Forest Timber Trees*. Clarendon Press, Oxford.
- CHAMPION, R.H. (1965) Wood-cutter's disease: contact sensitivity to lichens. *British Journal of Dermatology*, **77**, 285.
- CHAMPION, R.H. (1971) Atopic sensitivity to algae and lichens. *British Journal of Dermatology*, **85**, 551.
- CHAN-YEUNG, M., BARTON, G.M., MCLEAN, L. & GRZYBOWSKI, S. (1971) Bronchial reactions to Western Red Cedar (*Thuja plicata*). *Canadian Medical Association Journal*, **105**, 56.
- CHITTENDEN, F.J. (1931) Plants causing skin irritation. *The Gardener's Chronicle*. 24.10.31, pp. 332-334, 353.
- CHOW, Y.L. & QUON, H.H. (1968) Chemical constituents of the heartwood of *Mesua ferrea*. *Phytochemistry*, **7**, 1871.
- CILENTO, SIR R. (1944) *Some poisonous plants, sea and land animals of Australia and New Guinea*. Smith and Paterson, Brisbane.
- CLELAND, J.B. (1914) Plants, including fungi, poisonous or otherwise injurious to man in Australia. *Australasian Medical Gazette*, **35**, 541 & 569.

- CLELAND, J.B. (1925) Plants, including fungi, poisonous or otherwise injurious to man in Australia. *Medical Journal of Australia*, **ii**, 443.
- CLELAND, J.B. (1931) Plants, including fungi, poisonous or otherwise injurious to man in Australia. *Medical Journal of Australia*, **ii**, 775.
- COBE, H.M. (1930) Sensitivity due to Christmas trees. *Journal of Allergy*, **1**, 442.
- COCKER, W., DAHL, T., DEMPSEY, C. & McMURRY, T.B.H. (1962) Extractives from *Andira inermis*. *Journal of the Chemical Society*, 4906.
- CODD, L.E.W. (1951) *Trees and shrubs of the Kruger National Park*. Dept. of Agriculture, Pretoria.
- COHEN, H.I., MERIGAN, T.C., KOSEK, J.C. & ELDRIDGE, F. (1967) Sequoiosis: a granulomatous pneumonitis associated with redwood sawdust inhalation. *American Journal of Medicine*, **43**, 785.
- COOKE, R.G. & DOWD, H. (1952) Naphthoquinones from *Diospyros hebecarpa*. *Australian Journal of Scientific Research*, **5A**, 760.
- CORDERO, A. & LYNCH, H. (1951) Sensibilizacion profesional al aserrin de Lapacho. *Prensa Medica Argentina*, **38**, 838.
- CORNER, E.J.H. (1952) *Wayside Trees of Malaya*, 2nd edn. Govt. Printing Office, Singapore.
- CORNEVIN, C. (1887) *Des plantes vénéneuses*. Firmin-Didot, Paris.
- CROCKER, H.R. (1903) *Diseases of the Skin*, 3rd edn, p. 418. Lewis, London.
- CROW, K.D. (1970) Chloracne. *Transactions of the St John's Hospital Dermatological Society*, **56**, 79.
- CZIMATIS & HAGEMANN (1910) Ueber Erkrankungen durch Holzstaub. *Hygienische Rundschau*, **20**, 761.
- DANTIN-GALLEGO, J. & ARMAYOR, A.F. (1952) Some new toxic woods: some new manifestations of toxicity. *Industrial Medicine and Surgery*, **21**, 41.
- DASSLER, H.-G. & URZYNICOK, H. (1958) Über den Gerbstoff der Schwarzerle (*Alnus glutinosa* Gärtner.). *Holz als Roh- und Werkstoff*, **16**, 327.
- DAVIDSON, J.M. (1941) Toxic effects of Iroko, an African wood. *Lancet*, **i**, 38.
- DAVIS, G. (1970) Imported hardwood statistical trends. *Timber Trades Journal*, 28.2.70, pp. 31-34.
- DAVY, J.B. (1929) African 'Sandaleen' wood. *Tropical Woods*, **17**, 15.
- DAWSON, C.R. (1954) The toxic principle of Poison Ivy and related plants. *Record of Chemical Progress*, **15**, 39.
- DEMPSEY, C.B. & DONNELLY, D.M.X. (1963) Extractives of *Dalbergia latifolia*. *Chemistry and Industry*, 23.3.63, p. 491.
- DENIS, P. (1937) Un nouvel alcaloïde des Rubiacées: la rubradinine. *Bulletin de l'Académie Royale Belgique (classe Sciences)* 5e série, **23**, 174.
- DENIS, P. (1938) La mitraspécine, nouvel alcaloïde du *Mitragyna speciosa* Korthals. *Bulletin de l'Académie Royale Belgique (classe Sciences)* 5e série, **24**, 653.
- DIETRICH, H.H. (1958) Importance des constituants des bois pour leur utilisation. *Bois et Forêts des Tropiques*, **62**, 37.
- DIETRICH, H.H. (1964) Desoxylapachol in *Tabebuia* sp. *Naturwissenschaft*, **51**, 408.
- DIXON, W.E. (1911) The pharmacological action of South African Boxwood (*Gonioma kamassi*). *Proceedings of the Royal Society series B*, **83**, 287.
- DOERR, R. (1913) Allergie und Anaphylaxie. In: *Handbuch der pathogenen Mikroorganismen* (Ed. by W. Kolle and A. Wassermann), 2nd edn. vol. 2 (ii), p. 954. Fischer, Jena, Berlin.
- DOIG, A.T. (1949) Other lung diseases due to dust. *Postgraduate Medical Journal*, **25**, 639.
- DONNELLY, D.M.X., NANGLE, B.J., PRENDERGAST, J.P. & O'SULLIVAN, A.M. (1968) Isolation of R-5-o-methyl-latifolin from *Dalbergia cochinchinensis* Pierre. *Phytochemistry*, **7**, 647.
- DONNELLY, B.J., DONNELLY, D.M.X., O'SULLIVAN, A.M. & PRENDERGAST, J.P. (1969) The isolation and structure of melanoxin, a new dihydrobenzofuran from *Dalbergia melanoxylon*. *Tetrahedron*, **25**, 4409.
- DOWNING, J.G. & GURNEY, S.W. (1940) Dermatitis from cashew-nut oil. *Journal of Industrial Hygiene and Toxicology*, **22**, 169.
- DUBREUILH, W. (1931) L'eczéma des bûcherons. *Annales de Dermatologie et de Syphiligraphie*, **7**, s. 2, 199.
- EADE R.A., HINTERBERGER, H. & SIMES, J.J.H. (1963) Afrormosin (castanin, 6,4'-dimethoxy-7-hydroxy-isoflavone) from *Castanospermum australe* Cunn. et Fr. *Australian Journal of Chemistry*, **16**, 188.
- EARLE, K.V. (1938) Toxic effects of *Hippomane mancinella*. *Transactions of the Royal Society for Tropical Medicine and Hygiene*, **32**, 363.
- EATON, K.K. (1973) Respiratory allergy to exotic wood dust. *Clinical Allergy*, **3**, 307.
- EMANUEL, D.A., WENZEL, F.J. & LAWTON, B.R. (1966) Pneumonitis due to *Cryptostroma corticale* (maple bark disease). *New England Journal of Medicine*, **274**, 1413.
- ENGLISH, P.B. & GREY, L.P. (1943) Sap dermatitis and conjunctivitis caused by the wild fig (*Ficus tumila*). *Medical Journal of Australia*, **1**, 578.

- ENZELL, C. & ERDTMAN, H. (1957) The occurrence of Manool in *Cupressus sempervirens* L. *Acta Chemica Scandinavica*, **11**, 902.
- ESCARTEFIGUE, M. (1935) Dermo-épidermite eczématiforme . . . de palissandre. *Bulletin de la Société française de Dermatologie et de Syphiligraphie*, **42**, 670.
- EVANS, W. (1905) A note on teak dermatitis. *British Journal of Dermatology*, **17**, 447.
- EVELYN, J. (1664) *Silva: or, a Discourse of Forest Trees*. 5th edn (1729). London.
- EYTON, W.B., OLLIS, W.D., SUTHERLAND, I.O., GOTTLIEB, O.R., MAGALHAES, M.T. & JACKMAN, L.M. (1965) The Neoflavanoid group of natural products I-III. *Tetrahedron*, **31**, 2683.
- FARMER, R.H. (1972) *A Handbook of Hardwoods*, 2nd edn. HMSO, London.
- FEINBERG, S.M. and SCHOENKERMANN, B.B. (1940) Karaya and related gums as causes of atopy. *Wisconsin Medical Journal*, **39**, 734-736 and 786.
- FILHO, R.B. & GOTTLIEB, O.R. (1968) Oxiaininas A: Flavonas hexaoxygenades de *Apuleia leiocarpa*. *Anais da Academia Brasileira de Ciencias*, **40**, 151.
- FINDLAY, G.H. (1963) Dermatitis of 'poison ivy' type from an indigenous S. African plant—*Smodingium argutum*. *South African Medical Journal*, **37**, 883.
- FINDLAY, G.H., WHITING, D.A., EGGERS, S.H. & ELLIS, R.P. (1974) *Smodingium* (African 'poison ivy') dermatitis. *British Journal of Dermatology*, **90**, 535.
- FINDLEY, L.J. (1972) An unusual case of rosewood dermatitis of the genus *Dalbergia* (East Indian rosewood). *British Journal of Industrial Medicine*, **29**, 343.
- FLECKER, H. (1945) Injuries produced by plants in tropical Queensland. *Medical Journal of Australia*, **1**, 636.
- FLEMING, I. (1964) *You only live twice*. Cape, London.
- FOMBEUR, J.-P. (1972) A propos de cas récents de tumeurs ethmoïdo-maxillaires chez les travailleurs du bois. *Archives des Maladies professionnelles*, **33**, 453.
- FORSYTH, A.A. (1968) *British Poisonous Plants*, 2nd edn, Bulletin 161, Ministry of Agriculture, Fisheries and Food. HMSO, London.
- FOURNIER, E. (1965) Toxicité des herbicides et des protecteurs des bois. *Revue du Praticien*, **15**, 3793.
- FOUSSEREAU, J., BENEZRA, C. & OURISSON, G. (1967) Contact dermatitis from laurel. *Transactions of the St John's Hospital Dermatological Society*, **53**, 141.
- FOX, E.C. (1941) Mesquite wood dermatitis. *Archives of Dermatology and Syphilology*, **44**, 1098.
- FPRL (1963/4) Forest Products Research Laboratory, Princes Risborough, England. Unpublished circulars on irritant timbers.
- FREGERT, S. & RORSMAN, H. (1963) Hypersensitivity to Balsam of Pine and Spruce. *Archives of Dermatology*, **87**, 693.
- FREI (1932a) Dermatitis durch afrikanisches Teakholz. *Dermatologische Wochenschrift*, **94**, 27.
- FREI (1932b) Pockholzekzem infolge Sensibilisierung nach Trauma. *Zentralblatt für Haut- und Geschlechtskrankheiten*, **41**, 29.
- FREISE, F.W. (1932) Gesundheitsschädigungen durch Arbeiten mit giftigen Hölzern. Beobachtungen aus brasilianischen Gewerbebetrieben. *Archiv für Gewerbepathologie und Gewerbehygiene*, **3**, 1.
- FREISE, F.W. (1936) Vergiftungen durch Brasilianische Werkhölzer I, II. *Sammlung der Vergiftungsfällen*, **7 C**, 1 & 61.
- FREISE, F.W. (1937) Vergiftungen durch Brasilianische Werkhölzer III. *Sammlung der Vergiftungsfällen*, **8 C**, 13.
- FRÈREJACQUE, M. (1951) La mansonine, hétéroside digitalique de *Mansonia altissima*. *Comptes rendus de l'Académie des Sciences*, **233**, 1220.
- FRISON, E. (1948) Tecomahoutsoorten en Lapachol. *Pharmaceutisch tijdschrift voor België*, **25**, 33.
- GADE, K. (1921) Ueber pneumokoniosen mit Asthma bei Holzsägerei-arbeitern. *Münchener medizinische Wochenschrift*, **68**, 1144.
- GALEFFI, C., DELLE MONACHE, E.M., CASINOVI, C.G. & MARINI BETTOLO, G.B. (1969) A new Quinone from the heartwood of *Mansonia altissima* Chev: Mansonone L. *Tetrahedron Letters*, **40**, 3583.
- GALEWSKY (1905) Über Eucalyptus-Dermatitiden. *Dermatologische Zeitschrift*, **12**, 36.
- GAMBLE, J.S. (1902) *A Manuel of Indian Timbers*, 2nd edn. Reprinted by Bishen Singh Mahendra Pal Singh, Dehra Dun, 1972.
- GANDEVIA, B. (1970) Ventilatory capacity during exposure to Western Red Cedar. *Archives of Environmental Health*, **20**, 59.
- GANDEVIA, B. & MILNE, J. (1970) Occupational asthma and rhinitis due to Western Red Cedar (*Thuja plicata*), with special reference to bronchial reactivity. *British Journal of Industrial Medicine*, **27**, 235.
- GANSE, W. VAN (1968) Allergies respiratoires d'origine professionnelle provoquées par les bois exotiques. *Archives des Maladies professionnelles*, **29**, 205.

- GANZONI, M. (1929) Das Ekzem als Arbeitsschädigung und seine rechtliche Stellung in der Versicherung. *Schweizer medizinische Wochenschrift*, **59**, 1169.
- GAYER, S. (1928) *Die Holzarten und ihre Verwendung in der Technik*, 3rd edn. Jänecke, Leipzig.
- GELLÉRT, E. & WITKOP, B. (1952) Die Identität der Alkaloids Kamassin mit Quebrachamin. *Helvetica Chimica Acta*, **35**, 114.
- GENDERS, R. (1972) *A History of Scent*. Hamilton, London.
- GENNER, V. & BONNEVIE, P. (1938) Eczematous eruptions produced by leaves of trees and bushes. *Archives of Dermatology and Syphilology*, **37**, 583.
- GERARD, J. (1597) *The Historie of Plants* (Ed. by T. Johnson, 1636). London.
- GHILLINI, C.A. (1954) Un lichene causa di Allergosi cutanea. *Rivista de Anatomia e Patologica Oncologia*, **8**, 755.
- GIBSON, R.J.H. (1906) The physiological properties of 'West African Boxwood'. *Biochemical Journal*, **1**, 39.
- GIMLETTE, J.D. (1929) *Malay Poisons and Charm Cures*, 3rd edn. Churchill, London.
- GOLSE, M.J. (1937) Les plantes toxiques des Colonies. *Bulletin des Travaux de la Société de Pharmacie de Bordeaux*, **75**, 102.
- GOTTLIEB, O.R. & MORS, W.B. (1958) The chemistry of Rosewood. II: isolation and identification of cotoin and pinocembrin. *Journal of the American Chemical Society*, **80**, ii, 2263.
- GOUGEROT & BLAMOUTIER (1922a) Intolérance anaphylactique aux applications médicamenteuses externes . . . huile de cade. *Bulletin de la Société médicale des Hôpitaux de Paris*, **46**, 733.
- GOUGEROT & BLAMOUTIER (1922b) Dermite eczémateuse professionnelle du à la poudre de palissandre. *Bulletin de la Société médicale des Hôpitaux de Paris*, **46**, 739.
- GOUGEROT & DELAY (1932) Eczéma par sensibilisation au bois de palissandre. *Bulletin de la Société française de Dermatologie*, **39**, 1339.
- GOVINDACHARI, T.R., PAI, B.R., SUBRAMANIAM, P.S., RAO, U.R. & MUTHUKUMARASWAMY, N. (1967) Constituents of *Mesua ferrea* L. I: Mesuaxanthone A and B. *Tetrahedron*, **23**, 243.
- GRABHAM, M. (1905) Satinwoods and Dermatitis. *British Medical Journal*, **1**, 822.
- GRANA, P.C. (1946) Conjunctivitis and dermatitis due to 'beach apple'. Report of 13 cases. *Archives of Ophthalmology*, **35**, 421.
- GRESHOFF, M. (1909) Phytochemical investigations at Kew. *Kew Bulletin*, **10**, 397.
- GRIFFIOEN, K. (1949) Bevat Djeungdjinghout een giftige en irriterende Stof? *Tectona*, **39**, 175.
- GRONEMEYER, W. & FUCHS, E. (1967) Krankheiten durch inhalative Allergen-Invasion. In: *Lehrbuch der klinischen Allergie* (Ed. by K.Hansen and M.Werner). Thieme, Stuttgart.
- GROSSMANN, J. (1910) Gesundheitsschädliche Hölzer. *Bayrische Industrielle Gewerbeblatt*, **96**(6), 51.
- GROSSMANN, J. (1920) Gesundheitsschädliche Holzarten. *Der Holzkäufer* (Leipzig), **17**, 529, 535, 540 and 545.
- GUIBOURT, N.J.-B.G. (1849) *Histoire naturelle des Drogues simples*. Baillière, Paris.
- HAMEL, DU, H.L. (1811-1816) *Traité des Arbres et Arbustes qui se cultivent en France en pleine Terre*. Michel, Paris. New edition.
- HANCOCK, W.V. & SWAN, E.P. (1965) The petroleum ether soluble extractives . . . of Douglas fir. *Phytochemistry*, **4**, 791.
- HANSLIAN, L. & KADLEC, K. (1964a) Timber and timber dust. *Pracovní lékařství*, **16**, 276.
- HANSLIAN, L. & KADLEC, K. (1964b) Allergy caused by Larch wood. *Pracovní lékařství*, **16**, 362.
- HANSLIAN, L. & KADLEC, K. (1966) Dřevo z hlediska hygienického (VII) Biologicky silně agresivní dřeviny. *Dřevo*, **21**, 157.
- HART, G. (1955) *Timbers of South East Asia*. Timber Development Association, London.
- HAUSEN, B.M. (1970) *Untersuchungen über gesundheitsschädigende Hölzer*. Thesis, Hamburg. (See also Hausen, 1973.)
- HAUSEN, B.M. (1972) Untersuchungen zur Überempfindlichkeit gegen Sucupira- und Palisanderholz. *Berufsdermatosen*, **20**, 1.
- HAUSEN, B.M. (1973) *Holzarten mit gesundheitsschädigenden Inhaltsstoffen*. DRW-Verlags-GmbH, Stuttgart.
- HAUSEN, B.M., SIMATUPANG, M.H. & WEITBRECHT, U. (1971) Allergie gegen Bethabara-Holz. *Berufsdermatosen*, **19**, 324.
- HAY, J. (1907) Special report on the condition of the workers employed in the manufacture of shuttles from African Boxwood. *Report of the Chief Inspector of Factories and Workshops*, London, pp. 266-268.
- HEARST, P.J., SHAMMA, M., DUDOCK, B.S. & SHINE, R.J. (1968) Greenheart alkaloids III: Sepeerine (ocoteamine) and Demararine. *Journal of Organic Chemistry*, **33**, 1229.
- HEILIG, P.M. (1957) Ziekten veroorzaakt door bewerking van zekere houtsoorten. *Vakblatt Meubelindustrie*, **38**, 1440.

- HERING, H. (1966) Über Arbeitsdermatosen in der Holzverarbeitenden Industrie. *Dermatologische Wochenschrift*, **152**, 807.
- HERZHEIMER, K. (1912) Ueber die gewerblichen Erkrankungen der Haut. *Deutscher medizinische Wochenschrift*, **38**, 18.
- HEYL, U. (1966) Kontaktekzem bei Überempfindlichkeit gegen Sucupira- und Palisanderholz. *Berufsdermatosen*, **14**, 239.
- HINCKLEY, F.L. (1960) *Directory of the historic cabinet woods*. Bonanza, N.Y.
- HJORTH, N. (1961) Eczematous allergy to balsams. *Acta dermato-venereologica*, **41** (Suppl. 46), 1.
- HJORTH, N. (1965) Contact sensitivity to plants and balsams. *European Congress of Allergy, Acta dermato-venereologica*, pp. 65-79.
- HJORTH, N., FREGERT, S. & SCHILDKNECHT, H. (1969) Cross-sensitization between synthetic primin and related quinones. *Acta dermato-venereologica*, **49**, 552.
- HOFFMANN, H. (1926) Über Hautentzündungen nach Teakholzbearbeitung. *Zentralblatt für Gewerbehygiene*, NF **3**, 333.
- HOFFMANN, H. (1928) Über hautreizende Nutzhölzer. *Dermatologische Zeitschrift*, **53**, 293.
- HOLČÍK, L. (1959) Dermatitidy z *Rhus vernicifera*. *Československá dermatologie*, **34**, 93.
- HOLTZAPFEL, C. & ROYLE (1843) Descriptive catalogue of the woods commonly employed in this country for the mechanical and ornamental arts. An extract from: *Turning and mechanical manipulation*. Holtzapfel, London.
- HON, L.Y. (1967) Skin irritation caused by Tembusu (*Fagraea fragrans*). *Malayan Forester*, **30**, 234.
- HORAND, R. (1907) Mains de crocodile: dermatose professionnelle produite par le bois de chataigner. *Gazette des Hôpitaux*, **80**, 255.
- HORNER, S. & WIGLEY, J.E.M. (1936) A case of dermatitis venenata due to *Mansonia* wood (*Sterculiaceae altissima*). *British Journal of Dermatology*, **48**, 26.
- HORNSEY, J.F. (1914) Dermatitis venenata due to *Rungus*. *British Medical Journal*, **1**, 759.
- HOUNAM, R.F. & WILLIAMS, J. (1974) Levels of airborne dust in furniture making factories in the High Wycombe area. *British Journal of Industrial Medicine*, **31**, 1.
- HOWARD, A.L. (1934) *A manual of the timbers of the world*, 2nd edn. Macmillan, London.
- HOWELL, J.B. & BLAIR, D.S. (1950) Eczema of the hands from wooden-handled objects. *Archives of Dermatology and Syphilology*, **62**, 400.
- HUBLET, P., SPORCQ, J., OLEFFE, J. & HEYLEN, C. (1972) Les accidents cutanés et muqueux provoqués par les bois tropicaux. *Archives Belges de Médecine sociale, hygiène, médecine du travail et Médecine légale*, pp. 314-337.
- HURST, E. (1942) *The poisonous plants of New South Wales*. N.S.W. poisonous plants committee, Sydney.
- HURTADO, I.DE (1965) Contact dermatitis caused by the 'Manzanillo' (*Rhus striata*) tree. *International Archives of Allergy*, **28**, 321.
- HURTADO, I.DE (1968) Studies on the biological activity of *Rhus striata* ('Manzanillo'). 2. Skin response to patch tests in humans. *International Archives of Allergy*, **33**, 209.
- IRVINE, F.R. (1961) *Woody plants of Ghana*. Oxford University Press, London.
- ISEKI, K. (1932) Fall von Dermatitis acuta durch 'Aangot'-Baum (*Semecarpus venosa* Volk.). *Acta Dermatologica (Kyoto)*, **19**, 31.
- ITO, K. (1963) Allergic disorders of upper respiratory tract by sawdust of *Thuja standishii* (report 3). *Journal of Science and Labour (Tokyo)*, **39**, 501.
- ITO, K. (1964) An antigenic substance, beta-thujaplicin, in the steam-distillate of the sawdust of *Thuja standishii* Carr. *Medical Journal of Shinshu University*, **9**, 165.
- IWAKAWA, K. (1911) Über das entzündungserregende Pulver des japanischen Nutzholzes 'Tagayasan'. *Archiv für experimentelle Pathologie und Pharmacologie*, **65**, 315.
- JANSON, P. (1953) Citrusfrüchte und Hauterkrankungen. *Zeitschrift für Haut- und Geschlechtskrankheiten*, **14**, 144.
- JAY, B.A. (1950) *Timbers of West Africa*, 3rd edn. Timber Development Association, London.
- JOHN (1913) Dermatitis nach Teakholzbearbeitung. *Ärztliche Sachverständigen-Zeitung*, **8**, 170.
- JONES, H.E. (1904) Acute dermatitis produced by satinwood irritation. *British Medical Journal*, **1**, 1484.
- JONG, J.C.DE, LENSTRA, J.B. & VERMEER, J.H. (1951) Eczema due to the wood of *Peroba da campos*; isolation of the allergen. *Acta dermato-venereologica*, **31**, 108.
- KAPPEL, L.O. (1948) Balsam as a cause of contact dermatitis in a florist. *Annals of Allergy*, **6**, 21.
- KATZ, A.E. (1946) *Spice Mill*, **69**, 46, 50. Quoted in *Chemical Abstracts*, **40**, 7525.
- KATZENELLENBOGEN, I. (1955) Caterpillar dermatitis as an occupational disease. *Dermatologica*, **111**, 99.
- KEIL, H., WASSERMAN, D. & DAWSON, C.R. (1946) Mango dermatitis and its relationship to poison ivy hypersensitivity. *Annals of Allergy*, **4**, 268.

- KERN, A.B. (1960) Contact dermatitis from cinnamon. *Archives of Dermatology*, **81**, 599.
- KING, F.E. (1953) The chemistry of wood extractives. *Chemistry and Industry*, 1325.
- KING, F.E. & ACHESON, R.M. (1950) Afzelin (Kaempferol-3-rhamnoside), a new glycoside isolated from *Doussie*. *Journal of the Chemical Society*, 168.
- KING, F.E., BAKER, J.A. & KING, T.J. (1955) A saponin constituent of *Makoré* (*Mimusops heckelii*). *Journal of the Chemical Society*, 1338.
- KING, F.E., CLARK-LEWIS, J.W. & FORBES, W.F. (1955) EpiAfzelechin, a new member of the catechin series. *Journal of the Chemical Society*, 2948.
- KING, F.E. & GRUNDON, M.F. (1949, 1950) The constitution of chlorophorin, a constituent of Iroko, the timber of *Chlorophora excelsa*. *Journal of the Chemical Society* (1949) 3348; (1950) 3547.
- KING, F.E., GRUNDON, M.F. & NEILL, K.G. (1952) Constituents of the heartwood of *Ferreira spectabilis*. *Journal of the Chemical Society*, 4580.
- KING, F.E., HOUSLEY, J.R. & KING, T.J. (1954) Coumarin constituents of *Fagara macrophylla*, *Zanthoxylum flavum* and *Chloroxylon swietenia*. *Journal of the Chemical Society*, 1392.
- KING, F.E., KING, T.J. & MANNING, L.C. (1953) The constitution of Jacareubin, a pyranoxanthone from *Calophyllum brasiliense*. *Journal of the Chemical Society*, 3922.
- KING, F.E., KING, T.J. & ROSS, J.M. (1954) The constitution of Arjunolic acid, a triterpene from *Terminalia arjuna*. *Journal of the Chemical Society*, 3995.
- KING, F.E., KING, T.J. & ROSS, J.M. (1955) Isolation of a new triterpene (Terminolic acid) from *Terminalia ivorensis*. *Journal of the Chemical Society*, 1333.
- KING, F.E., KING, T.J. & STOKES, P.J. (1954) The structure of further new flavones occurring in Ayan (*Distemonanthus benthamianus*); Distemonanthin. *Journal of the Chemical Society*, 4587, 4594.
- KING, F.E. & MORGAN, J.W.W. (1960) The constitution of Katonic acid, a triterpene from *Sandoricum indicum*. *Journal of the Chemical Society*, 4738.
- KLIGMAN, A.M. (1957) Poison ivy (*Rhus*) dermatitis. *Archives of Dermatology*, **77**, 149.
- KNOCH, H., OURISSON, G., PEROLD, G.W., FOUSSEREAU, J. & MALEVILLE, J. (1969) Allergenic component of a liverwort: a sesquiterpene lactone. *Science, N.Y.*, **166**, 239.
- KOELSCH (1931) Die Begutachtung der gewerblichen Dermatosen im Sinne der Verordnung vom 11 Februar 1929. *Zentralblatt für Haut- und Geschlechtskrankheiten*, **37**, 1.
- KOMATSU, F. (1963) Respiratory allergy in woodworkers. 14th International Congress of Occupational Health. *Excerpta Medica*, **62**, 1748.
- KRAIS, P. (1910) *Gewerbliche Materialkunde*, Vol. 1: Die Hölzer. Kraiss, Stuttgart.
- KROGH, H.K. (1962) Contact eczema caused by true teak (*Tectona grandis*). *British Journal of Industrial Medicine*, **19**, 42.
- KROGH, H.K. (1964) Contact eczema caused by true teak. *British Journal of Industrial Medicine*, **21**, 65.
- KUSKE, H. (1939) Experimentelle Untersuchungen zur Photosensibilisierung der Haut durch pflanzliche Wirkstoffe. *Archiv für Dermatologie und Syphilis*, **178**, 112.
- LAGRANGE, H. (1923) Conjonctivite d'origine anaphylactique. *Presse médicale*, **31**, 112.
- LAIDLAW, R.A. & SMITH, G.A. (1959) Heartwood extractives of some timbers of the family Moraceae. *Chemistry and Industry*, 1604.
- LAMB, F.B. (1966) *Mahogany of tropical America*. University of Michigan, Ann Arbor.
- LANCET (1896) Letters from 'H.N.A.' (i, 1113), 'M.B.' (i, 1193) and 'M.R.C.S. &c.' (i, 1265).
- LANDE, I.S. DE LA (1948) The alkaloids of *Cryptocarya pleurosperma*. *Australian Journal of Experimental Biology*, **26**, 181.
- LANDOR, J.V. (1943) Dermatitis venenata caused by smoke. *British Journal of Dermatology*, **55**, 17.
- LASLETT, T. (1894) *Timber and timber trees*, 2nd edn, p. 226. Macmillan, London.
- LE COULANT, M.P. & LOPÈS, G. (1956a) A propos des dermites des bois. *Journal médicale de Bordeaux*, **133**, 245.
- LE COULANT, M.P. & LOPÈS, G. (1956b) A propos des dermites aux sciures de bois. *Bulletin de la Société française de Dermatologie et de Syphiligraphie*, **63**, 80.
- LE COULANT, M.P., TEXIER, MALEVILLE, GÉNIAUX, TAMISIER & BANCONS (1966) L'allergie au frullania: son rôle dans la 'dermite du bois de chene'. *Bulletin de la Société française de Dermatologie et de Syphiligraphie*, **73**, 440.
- LEGGE, T.M. (1905/6/7) *Reports of the Chief Inspector of Factories and Workshops*: (1905) 380, (1906) 32, (1907) 248. London. See also HAY (1907).
- LEIDER, M. & SCHWARTZFELD, H.K. (1950) Allergic eczematous contact type dermatitis caused by cocobolo wood (*Dalbergia*). *Archives of Dermatology and Syphilology*, **62**, 125.
- LEVIN, S.J. (1941) Cocobolo wood dermatitis. *Journal of Allergy*, **12**, 498.

- LEWIN, L. (1928) *Gifte im Holzgewerbe*. Stilke, Berlin.
- LEWIN, L. (1962) *Gifte und Vergiftungen*. Haug, Ulm.
- LEWIS, R. (1929) Palisanderholzdermatitis. *Zentralblatt für Haut- und Geschlechtskrankheiten*, **30**, 8.
- LIGON, R. (1673) *A True and Exact History of the Island of Barbados*. Parker, London.
- LIMA, A.O. (1953) Über das antigene Verhalten der Olharze einiger Gattungen der Familie Anacardiaceae. *International Archives of Allergy and applied Immunity*, **4**, 169.
- LINDLEY, J. (1838) *Flora medica*. Longman, London.
- LIPPARONI, E. (1951) Dermatiti da zecche e dermatiti da sostanze vegetali. *Archivio italiano di Scienze Mediche Tropicali*, **32**, 913.
- LIVINGOOD, C.S., ROGERS, A.M. & FITZ-HUGH, T. (1943) Dhoobie-mark dermatitis. *Journal of the American Medical Association*, **123**, 23.
- LONGIN, L.A. (1929) Une triade éruptive provoquée par les essences forestières. *Annales de Dermatologie et de Syphiligraphie*, **10**, 178.
- LORO, H.-A.-M. (1923) L'urticaire de l'Iroko. *Archives de Médecine et de Pharmacie Navales*, **114**, 136.
- LOUDON, J.C. (1844) *Arboretum et Fruticetum Britannicum*, 2nd edn. Longman, London.
- LULLO, O.DI (1928) Le 'Paa', dermite provoquée par le quebracho rouge. *Comptes rendus des Séances de la Société de Biologie*, **99**, 1000.
- LULLO, O.DI (1934) 'El páa', une nouvelle dermatite vénéneuse. *Revue sud-américaine de Médecine et de Chirurgie*, **5**, 513.
- MCCABE, P.H., MCCRINDLE, R. & MURRAY, R.D.H. (1967) Constituents of sneezewood, *Ptaeroxylon obliquum* (Thunb.) Radlk. Part 1: chromones. *Journal of the Chemical Society*, 145.
- MACKEE (1913) Dermatitis venenata from coco-bolo wood. *Journal for Cutaneous and Genito-urinary Diseases*, **31**, 582.
- MACKENNA, R.M.B. & HORNER, S. (1954) Occupational skin diseases. In: *Industrial Medicine and Hygiene* (Ed. by E.R.A. Merewether). Butterworth, London.
- McKENNIS, H. JR., HEARST, P.J., DRISKO, R.W., THORNDYKE ROE JR. & ALUMBAUGH, R.L. (1956) Isolation of a tetramethoxylated alkaloid from Demerara greenheart. *Journal of the American Chemical Society*, **78**, 245.
- McLEAN, S. & MURRAY, D.G. (1970) Isolation of indole (beta-carboline), pyridine and indole-pyridine alkaloids from *Nauclea diderrichii*. *Canadian Journal of Chemistry*, **48**, 867-868.
- MACMILLAN, H.F. (1956) *Tropical planting and gardening with special reference to Ceylon*, 5th edn. Macmillan, London.
- MACPHERSON, J. (1925a) The toxicology of Eucalyptus oil. *Medical Journal of Australia*, **ii**, 108.
- MACPHERSON, J. (1925b) Dermatitis caused by Queensland Maple. *Medical Journal of Australia*, **ii**, 542.
- MAIBACH, H.I. & JOHNSON, H.L. (1975) Contact urticaria syndrome. *Archives of Dermatology*, **111**, 726.
- MAIDEN, J.H. (1909, 1916, 1920) On some plants which cause inflammation or irritation of the skin. *Agricultural Gazette of New South Wales*, **20**, 1073 (1909); **27**, 39 & 212 (1916); **31**, 386 (1920).
- MAIDEN, J.H. (1919) Notes on *Acacia*, no. IV. *Journal of the Proceedings of the Royal Society of New South Wales*, **53**, 219-220 (whole paper 171-238 + plates).
- MAJIMA, R. (1922) Chemische Untersuchung der verschiedenen natürlichen Lackarten. *Berichte der deutschen chemischen Gesellschaft*, **55**, 191.
- MALESPINE, E. (1935) L'eczéma du bois. *Annales d'hygiène publique, industrielle et sociale*, **13**, 313.
- MARINI-BETTÒLO, G.B., CASINOVÌ, C.G. & GALEFFI, C. (1965) A new class of quinones: sesquiterpene quinones of *Mansonia altissima* Chev. *Tetrahedron Letters*, **52**, 4857.
- MARKIN, L.E. (1930) Boxwood sensitiveness. *Journal of Allergy*, **1**, 346.
- MASCRÉ, M. & PARIS, R. (1939) Sur l'écorce de dô et ses propriétés digitales. *Bulletin des Sciences Pharmacologiques*, **46**, 145.
- MATTHES, H. & SCHREIBER, E. (1914) Über hautreizende Hölzer. *Berichte der deutschen pharmakologischen Gesellschaft*, **24**, 385.
- MAY, S.B. (1960) Dermatitis due to *Grevillea robusta* (Australian silk oak). *Archives of Dermatology*, **82**, 1006.
- MEISTER, H. (1934) Ueber eine neue Aetiologie für Gesichtsekzeme. *Schweizerische medizinische Wochenschrift*, **ii**, 993.
- MENEGHINI, C.L. & RUBINI, G. (1958) Le dermatiti professionali nell'industria del legno. *Minerva dermatologica*, **33**, 122.
- MERCK (1968) *Merck Index*. Merck, Rahway, N.J.
- MERRILL, E.D. (1944) Dermatitis caused by various representatives of the Anacardiaceae. *Journal of the American Medical Association*, **124**, 222.
- MILHAM, S. & HESSER, J.E. (1967) Hodgkin's disease in woodworkers. *Lancet*, **ii**, 136.

- MIRANDA BASTOS, A.D. & MATOS FILHO, A.DE (1962) A 'Jacaranda' timber causing dermatitis. *Proceedings of the 5th Forestry Congress*, **3**, 1414.
- MITCHELL, C. (1970) Occupational asthma due to Western or Canadian red cedar (*Thuja plicata*). *Medical Journal of Australia*, **57**(ii), 233.
- MITCHELL, J.C. (1965) Allergy to lichens. *Archives of Dermatology*, **92**, 142.
- MITCHELL, J.C. & ARMITAGE, J.S. (1965) Dermatitis venenata from lichens. *Archives of Environmental Health*, **11**, 701.
- MITCHELL, J.C., DUPUIS, G. & GEISSMAN, T.A. (1972) Allergic contact dermatitis from sesquiterpenoids of plants. *British Journal of Dermatology*, **87**, 235.
- MITCHELL, J.C., FRITIG, B., SINGH, B. & TOWERS, G.H.N. (1970) Allergic contact dermatitis from *Frullania* and *Compositae*. *Journal of Investigative Dermatology*, **54**, 233.
- MITCHELL, J.C., SCHOFIELD, W.B., SINGH, B. & TOWERS, G.H.N. (1969) Allergy to *Frullania*. *Archives of Dermatology*, **100**, 46.
- MOLL, F. (1950) Giftiges Holz und Gewerbekrankheiten. *Holz (München)*, **4**, 76.
- MONTAGU, LADY M.W. (1717) *Complete Letters* (Ed. by R. Halsband). Oxford University Press (1965). Letter to Lady Rich of 17.6.1717.
- MORGAN, J.W.W., ORSLER, R.J. & WILKINSON, D.J. (1968) Dermatitis due to the wood dusts of *Khaya anthotheca* and *Machaerium scleroxylon*. *British Journal of Industrial Medicine*, **25**, 119.
- MORGAN, J.W.W. & THOMSON, J. (1967). Ayan dermatitis. *British Journal of Industrial Medicine*, **24**, 156.
- MORGAN, J.W.W. & WILKINSON, D.S. (1965a) Dermatitis produced by wood. *International Union of Forestry Research Organisations Proceedings of Meetings Section 41*, **3**, 1.
- MORGAN, J.W.W. & WILKINSON, D.S. (1965b) Sensitization to *Khaya anthotheca*. *Nature*, **207**, 1101.
- MORS, W.B., GOTTLIEB, O.R. & DJERASSI, C. (1957) The chemistry of Rosewood. Isolation and structure of anibine and 4-methoxyxparacetoin. *Journal of the American Chemical Society*, **79**, 4507.
- MUENSCHER, W.C. (1951) *Poisonous plants of the U.S.A.*, 2nd edn (reprinted 1964). Macmillan, N.Y.
- MURRAY, R.D.H. & BALLANTYNE, M.M. (1969) Nieshoutol, a sternutatory hydroxycoumarin from sneezewood. *Tetrahedron Letters*, **46**, 4031.
- NESTLER, A. (1911) Die hautreizende Wirkung des Amberholzes (*Liquidambar styraciflua* L.). *Berichte der deutschen botanischen Gesellschaft*, **29**, 672.
- NESTLER, A. (1912) Die hautreizende Wirkung des Cocoboloholzes. *Berichte der deutschen botanischen Gesellschaft*, **30**, 120.
- NESTLER, A. (1913) Die hautreizende Wirkung des roten Hartriegels und der Kornelkirsche. *Die Umschau*, **17**, 860.
- NESTLER, A. (1924) Hautreizende Hölzer. *Umschau*, **28**, 1007.
- NESTLER, A. (1926) Die hautreizende Wirkung des sogenannten 'Padouk-Holzes'. *Planta (Archiv für wissenschaftliche Botanica)*, **2**, 537.
- NESTLER, A. (1929) Hautreizende Pflanzen. *Umschau*, **33**, 611.
- NEUDÖRFFER, R. (1902) Ein Fall von Vergiftung durch die Douglasfichte (*Tsuga douglasii*). *Zentralblatt für innere Medizin*, **23**, 993.
- NICOLAS, J. & PÉTOURAUD, C. (1935) Dermite eczématiforme du bras à la suite du port d'un bracelet d'ébène. *Bulletin de la Société française de Dermatologie et de Syphiligraphie*, **42**, 27.
- NOLL, R. (1931) Citronenholzmehl-Uberempfindlichkeit. *Zentralblatt für Haut- und Geschlechtskrankheiten*, **38**, 437.
- NOMENCLATURE GÉNÉRALE (1965) *Nomenclature générale des bois tropicaux*. Association technique internationale des bois tropicaux, Nogent-sur-Marne.
- NORDIN, J. (1947) *Yrkessjukdomar* (Industrial diseases), **2**, 605. Uppsala.
- NOTT, H. (1925) discussing CLELAND (1925). *Medical Journal of Australia*, **ii**, 464.
- OCOLOWITZ, J.L. & WRIGHT, A.S. (1962) 5-(10-pentadecenyl) resorcinol from *Grevillea puramidalis*. *Australian Journal of Chemistry*, **15**, 858.
- OEHLING, A. (1963) Berufsalergie im Holzgewerbe. *Allergie und Asthma*, **9**, 312.
- OESTERLE, O.A. (1913) Über das 'Tekomin'. *Archiv der Pharmazie*, **251**, 301.
- OESTERLE, O.A. (1916) Über einen Begleiter des Lapachols im Greenheartholz. *Archiv der Pharmazie*, **254**, 346.
- OLIVER, THOMAS (1902) *Dangerous Trades*, p. 790. Murray, London.
- OLIVER, THOMAS (1908) *Diseases of Occupation*, pp. 258-260. Methuen, London.
- OPDYKE, D.L.J. (1974) Monographs on Fragrance Raw Materials. *Food and Cosmetics Toxicology*, **12**, 807.
- OPPENHEIM (1909) (Satinholzdermatitis) *Archiv für Dermatologie und Syphilis*, **96**, 97.
- OPPENHEIM, M. (1913) Buchsbaumermatitis bei einem Gärtner. *Osterreichisches Sanitätswesen*, **25**, 1291. Quoted by HAUSEN (1970).

- ORDMAN, D. (1949a) Bronchial asthma caused by the inhalation of wood dust. *Annals of Allergy*, **7**, 492.
- ORDMAN, D. (1949b) Wood dust as an inhalant allergen. Bronchial asthma caused by kejaat wood (*Pterocarpus angolensis*). *South African Medical Journal*, **23**, 973.
- ORSLER, R.J. (1969) The effects of irritant timbers. *Timberlab papers* no. 11. Forest Products Research Laboratory Princes Risborough.
- ORTEGA, J.G. (1926) Amapa prieta. *Mexico Forestal*, **4**, 3 & 31. Quoted by RECORD in *Tropical Woods*, **7**, 37 (1926).
- PARDO-COSTELLO, V. (1923) Dermatitis venenata; a study of the tropical plants producing dermatitis. *Archives of Dermatology and Syphilology*, **7**, 81.
- PARDY, A.A. (1954) Notes on indigenous trees and shrubs of Southern Rhodesia. *Rhodesia agricultural Journal*, **51**, 489.
- PAUTRIER, L. (1903) Chrysarobin. *Revue pratique des Maladies cutanées, syphilitiques et vénériennes* Oct., Nov., Dec. 1903. Summary by A.SHILLITOE in *British Journal of Dermatology*, **16**, 399 (1904).
- PECKOLT, T. (1873) Über *Ipé tabaco* und seinen Gehalt an Chrysophansäure. *Zeitschrift des Allgemeinen Österreichischen Apothekervereins*, **11**, 549.
- PECKOLT, T. (1909, 1913) Heil- und Nutzpflanzen Brasiliens. *Berichte der deutschen pharmazeutischen Gesellschaft*, **19**, 529; **22**, 24.
- PELIKAN, M.E. (1866) Nouvelles recherches sur le poison du *Nerium oleander*. *Comptes rendus de l'Académie des Sciences*, **62**, 237.
- PEREIRA, M.O. DE SILVA, GOTTLIEB, O.R. & MAGALHAES, M.T. (1966) A química de Gutíferas brasileiras. IX: Constituintes xantônicos do *Calophyllum brasiliense*. *Anais da Academia brasileira de Ciências*, **38**, 425.
- PERI, A. (1910) La lavorazione della corda di trucioli di pino nelle fonderie di tubi di ghisa. Le lesioni cutanee delle mani delle cordaie. *Il Ramazzini* (Firenze), **4**, 383. Quoted by HAUSEN (1970).
- PERRINS, J.D. (1852) Ueber das Vorkommen von Berberin in dem Columboholz von Ceylon (*Menispermum fenestratum* der Botaniker). *Annalen der Chemie und Pharmazie*, **83**, 276.
- PFLANZ, V. (1908) Interessante Fälle von 'Dermatitis venenata'. *Medizinische Klinik*, **4**, 832.
- PHILIPPE, J., GUIBERT, L. & COMBES, R. (1965) Considérations sur les allergies sylvaines. *Revue française d'Allergie*, **5**, 95.
- PHILLIPS, E.W.J. (1966) Dermatitis caused by a rosewood substitute. *Wood*, **31**, 44.
- PILLAY, P.P. & SIDDIQUI, S. (1931) Chemical examination of the marking nut (*Semecarpus anacardium* L.). *Journal of the Indian Chemical Society*, **8**, 517.
- PILLON & MARTINET (1935) Sur huit cas de dermatite par bois exotique. *Bulletin de la Société française de Dermatologie et de Syphiligraphie*, **42**, 380.
- PIORKOWSKI, F.O. (1944) Woodworker's dermatitis in East Africa. *East African Medical Journal*, **21**, 60.
- PIRILÄ, V., SILTANEN, E. & PIRILÄ, L. (1964) On the chemical nature of the eczematogenic agent in oil of turpentine. *Dermatologica*, **128**, 16.
- PLINY (the elder). *Natural History* (Ed. by J.Bostock and H.T.Riley, 1855). Bohn, London, Vol. 3, p. 360. (Book XVI, chap. 20.)
- POLONSKY, J. & LEDERER, E. (1959) Note sur l'isolement de la diméthoxy-2,6-benzoquinone des écorces et du bois de quelques Simarubacées et Méliacées. *Bulletin de la Société Chimique de France*, **1157**.
- PONSINET, G. & OURISSON, G. (1965, 1968) Etudes chimio-taxonomiques dans la famille des Euphorbiacées. *Phytochemistry*, **4**, 813; **7**, 89.
- PRÉFONTAINE, DE (1763) *Maison rustique, à l'usage de Cayenne*, pp. 139, 152, 208-209. Bauche, Paris.
- RAGOT, A. & BRUN, J.R. (1948) Les dermatoses professionnelles du bois d'Iroko. *9th International Congress of Industrial Medicine*, pp. 354-8. Wright, Bristol.
- RAMAZZINI, BERNARDINO (1700) *De morbis artificum diatriba* (Ed. by A.Pazzini, 1953). Rome, Columbus. Chap. 6 in supplement.
- RASCH, H. (1934) Poisonous woods. In: *Occupation and Health*, Vol. 2, pp. 680-685. International Labour Office, Geneva.
- RAYMOND, V. (1959) Dermatoses professionnelles dans le bâtiment. *Revue du Praticien*, **9**, 2683.
- RAYMOND, W.D. (1936) The poisonous effects of some local species of *Euphorbia*. *East African Medical Journal*, **12**, 369.
- RECORD, M. (1945) A collection of woody plants from Melanesia. *Tropical Woods*, **81** (*Semecarpus*, p. 11).
- RECORD, S.J. (1925) Lapachol. *Tropical Woods*, **1**, 7.
- RECORD, S.J. (1926) (*Machaerium*) *Tropical Woods*, **8**, 18.
- RECORD, S.J. (1929) Walnut woods—true and false. *Tropical Woods*, **18**, 4.
- RECORD, S.J. & GARRATT, G.A. (1923) *Cocobolo*. Yale University School of Forestry Bulletin no. 8. New Haven.
- RECORD, S.J. & HESS, R.W. (1943) *Timbers of the New World*. Yale, New Haven.

- RECORD, S.J. & MELL, C.D. (1924) *Timbers of Tropical America*. Yale, New Haven, and Milford/Oxford University Press, London.
- RENDLE, B.J. (1956) Variation in the quality of African mahogany. *Wood*, **21**, 349.
- RICHARD (1843) *Journal de Chimie médicale, de Pharmacie et de Toxicologie (2nd series)*, **9**, 392.
- RICHET, C. (1909, 1910) Etudes sur la crépitine (toxine de *Hura crepitans* *Annales de l'Institut Pasteur, Paris*, **23**, 745; **24**, 609.
- RIDLEY, H.N. (1922) Plant dermatitis. *Journal of tropical Medicine and Hygiene*, **25**, 225.
- RIDLEY, H.N. (1924) Poisoning by bamboo hairs. *Journal of tropical Medicine*, **27**, 278.
- RIDLEY, D.D., RITCHIE, E. & TAYLOR, W.C. (1968) Some further constituents of *Grevillea robusta* A.Cunn. *Australian Journal of Chemistry*, **21**, 2979.
- RITCHIE, E. (1964) Chemistry of *Flindersia* species. *Review of pure and applied Chemistry*, **14**, 47.
- RITCHIE, E., TAYLOR, W.C. & VAUTIN, S.T.K. (1965) Chemical studies of the Proteaceae: *Grevillea robusta* A.Cunn. and *Orites excelsa* R.Br. *Australian Journal of Chemistry*, **18**, 2015.
- ROCHAIX, A. & VIEUX, G. (1936) Sur une dermatose provoquée par le 'bois d'olon'. *Revue d'Hygiène*, **58**, 590.
- ROCKSTRO, R.S. (1890) *The Flute*, 2nd edn, pp. 141-142. Rudall Carte, London (1928).
- SACHS, O. (1926) Beitrag zur Frage der Überempfindlichkeit der Haut. *Wiener medizinische Wochenschrift*, **76**, 933.
- SALAMONE, L., BLASI, S. DI & CONIGLIO, L. (1969) Rilievi sulla patologia da legno di *Mansonia*. *Folia medica (Napoli)*, **52**, 427.
- SANDERMANN, W. & BARGHOORN, A.-W. (1955) Über die Inhaltsstoffe von Makoré- und Peroba-Holz sowie ihre gesundheitsschädigende Wirkung. *Holzforschung*, **9**, 112.
- SANDERMANN, W. & BARGHOORN, A.-W. (1956) Gesundheitsschädigende Hölzer. *Holz als Roh- und Werkstoff*, **14**, 37 & 87.
- SANDERMANN, W. & DIETRICH, H.H. (1959) Über die Inhaltsstoffe von *Mansonia altissima* und ihre gesundheitsschädigende Wirkung. *Holz als Roh- und Werkstoff*, **17**, 88.
- SANDERMANN, W. & LANGE, W. (1967) Chemische Untersuchung des Holzes von Angélique (*Basralocus—Dicorynia guianensis* Amsh.). *Holzforschung*, **21**, 154.
- SANDERMANN, W. & SIMATUPANG, M.H. (1961) Zur Chemie der Teaks, eines ungewöhnlichen Holzes. *Chemikerzeitung*, **85**, 38.
- SANDERMANN, W. & SIMATUPANG, M.H. (1962) Ein toxisches Chinon aus Teakholz. *Angewandte Chemie*, **74**, 782.
- SANDERMANN, W. & SIMATUPANG, M.H. (1966) Zur Chemie und Biochemie des Teakholzes. *Holz als Roh- und Werkstoff*, **24**, 190 (Review).
- SANDERMANN, W., SIMATUPANG, M.H. & WENDEBORN, W. (1968) Neue Chinone aus dem Kernholz von *Paratecoma peroba* Kuhl. *Naturwissenschaft*, **55**, 38.
- ŠANTAVÝ, F. & REICHSTEIN, T. (1948) Evonosid, ein kristallisiertes, herzwirksames Glykosid aus *Euonymus europaea* L. *Helvetica Chimica Acta*, **31**, 1655.
- SARGENT, C.S. (1896) *The Sylva of North America*, Vol. 10, p. 120. Houghton, Mifflin, Boston & New York.
- SATULSKY, E.M. & WIRTS, C.A. (1943) Dermatitis venenata caused by the Manzanillo tree. *Archives of Dermatology and Syphilology*, **47**, 797.
- SCADDING, J.G. (1967) *Sarcoidosis*. Eyre & Spottiswoode, London.
- SCHEPERS, G.W.H. (1964) In: *Sensitivity Chest Diseases* (Ed. by M.C.Harris and N.Shure). Davis, Philadelphia. (Suberosis.)
- SCHVEN, H., GRONEMEYER, W. & FUCHS, E. (1963) Zum Antigenkatalog gewerblicher Inhalationsallergien. *Allergie und Asthma*, **9**, 286.
- SCHIFF, B.L. (1951) Contact dermatitis caused by bamboo. *Archives of Dermatology and Syphilology*, **64**, 66.
- SCHILDKNECHT, H., BAYER, I. & SCHMIDT, H. (1967) Struktur des Primelgiftstoffes. *Zeitschrift für Naturforschung*, **B 22**, 36; 287.
- SCHLUETER, D.P., FINK, J.N. & HENSLEY, G.T. (1972) Wood-pulp workers' disease - a hypersensitivity pneumonitis caused by *Alternaria*. *Annals of Internal Medicine*, **77**, 907.
- SCHMIEG, K. (1926) Notes on new cabinet woods from Brazil. *Tropical Woods*, **5**, 1.
- SCHOENTAL, R. (1973) Carcinogenicity of wood shavings. *Laboratory Animals*, **7**, 47.
- SCHONWALD, P. (1929) discussing BLACK (1929). *Journal of Allergy*, **1**, 87.
- SCHREIBER, M.M., SHAPIRO, S.I. & BERRY, C.Z. (1971) Cactus granulomas of the skin. *Archives of Dermatology*, **104**, 374.
- SCHRÖPL, E. (1935) Eczema from granadilla wood. *Urological and Cutaneous Reviews*, **39**, 571.
- SCHULMANN, E. & DÉTOUILLON, P. (1932) L'eczéma du bois et la sensibilisation sylvestre. *Paris Médical*, **1**, 55.

- SCHULZ, K.H. (1957) Allergische Kontaktdermatitis durch exotische Hölzer, insbesondere durch Kambala-Teakholz. *Berufsdermatosen*, **5**, 238.
- SCHULZ, K.H. (1962) Untersuchungen über die sensibilisierende Wirkung von Inhaltsstoffen Hölzer. *Berufsdermatosen*, **10**, 17.
- SCHULZ, K.H. (1965) Allergische Kontaktdermatitis durch tropische Hölzer. *Dermatologia Internationalis*, **4**, 121.
- SCHULZ, K.H. (1967) Berufsdermatosen — ausgewählte Kapitel. *Zeitschrift für Haut- und Geschlechtskrankheiten*, **42**, 499.
- SCHULTZ, K.H. & DIETRICH, H.H. (1962) Chinone als sensibilisierende Bestandteile von Rio-Palisander (*Dalbergia nigra*) und Cocobolo (*D. retusa*) Holz. *Allergie und Asthma*, **8**, 125.
- SCHUR, A. (1932) Dermatitis venenata; report of a case due to the Osage orange. *Archives of Dermatology and Syphilology*, **26**, 312.
- SCHWARTZ, L. (1931) Dermatitis venenata due to contact with Brazilian walnut wood. *Public Health Reports (Washington)*, **46**, 1938.
- SCHWARTZ, L., BIRMINGHAM, D.J., CAMPBELL, P.C. & MASON, H.S. (1945) Skin hazards in the manufacture and use of cashew nut shell liquid formaldehyde resins. *Industrial Medicine*, **14**, 500.
- SCHWARTZ, L., TULIPAN, L. & BIRMINGHAM, D.J. (1957) *Occupational diseases of the skin*, 3rd edn. Kimpton, London.
- SCHWARZKOPF, K. (1954) Über Hautschäden durch Holzschutzmittel. *Zeitschrift für Haut- und Geschlechtskrankheiten*, **16**, 6.
- SCHWEISHEIMER, W. (1952) Wood dust and respiratory diseases. *Wood*, **17**, 181.
- SENEAR, F.E. (1933) Dermatitis due to woods. *Journal of the American Medical Association*, **101**, 1527.
- SÉZARY, A. & DEVAL, L. (1932) Dermite artificielle causée par des gants noirs. *Bulletin de la Société française de Dermatologie et de Syphiligraphie*, **39**, 1370.
- SHERATON, T. (1803) *The cabinet dictionary*. London.
- SHEVLYAKOV, L.V. (1969) On dermatitis caused by tropic species of wood. *Vestnik Dermatologii i Venerologii*, **43**, 73.
- SIEGEL, J.M. (1954) Dermatitis due to black walnut juice. *Archives of Dermatology and Syphilology*, **70**, 511.
- SIEGHEIM (1909) Ueber Satinholzdermatitis. *Berlin klinische Wochenschrift*, **46**, 2020.
- SIEMENS, H.W. (1929) Strichförmige akute Dermatitis. *Dermatologische Zeitschrift*, **55**, 257.
- SIMATUPANG, M.H., DIETRICH, H.H. & GOTTWALD, H. (1967) Über die hautreizenden Stoffe in *Vatairea guianensis* Aubl. *Holzforschung*, **21**, 89.
- SIMMONS, J.S. & BOLIN, Z.E. (1921) Dermatitis venenata produced by an irritant present in the stem sap of the mango (*Mangifera indica* L.). *American Journal of Tropical Medicine*, **1**, 351.
- SIMONS, R.D.G. (1953) *Handbook of tropical dermatology and medical mycology*, Vol. 2, pp. 1444–1452. Elsevier, Amsterdam.
- SMITH, E.P. (1920) Plant dermatitis. *Journal of Botany*, **58**, 130.
- SNOW, J.S. & HARLEY, R.D. (1944) Dermatitis venenata and keratoconjunctivitis caused by the manzanillo tree. *Archives of Dermatology and Syphilology*, **49**, 236.
- SOSMAN, A.J., SCHLUETER, D.P., FINK, J.N. & BARBORIAK, J.J. (1969) Hypersensitivity to wood dust. *New England Journal of Medicine*, **281**, 977.
- SOUSA, J.R. DE, GOTTLIEB, O.R. & MAGALHAES, M.T. (1967) Neoflavanoides nos gêneros *Goniorrhachis* e *Peltogyne*. *Anais da Academia brasileira de Ciências*, **39**, 227.
- SOWERS, W.F., WEARY, P.E., COLLINS, O.D. & CAWLEY, E.P. (1965) Ginkgo-tree dermatitis. *Archives of Dermatology*, **91**, 452.
- SPIERS, P.S. (1969) Hodgkin's disease in workers in the wood industry. *Public Health Reports, Washington*, **84**, 385.
- SPILLMAN, M.L. (1921) Dermite artificielle due à l'action du chêne. *Bulletin de la Société française de Dermatologie et de Syphiligraphie*, **28**, 33.
- SPITZER, E. (1927) Gewerbedermatitis nach Okoméholz. *Zeitschrift für Haut- und Geschlechtskrankheiten*, **22**, 615.
- SPRAGUE, T.A. (1921) Plant dermatitis. *Journal of Botany*, **59**, 308.
- STANDLEY, P.C. (1927) Poisonous trees of Central America. *Tropical Woods*, **9**, 3.
- STARKE, J.C. (1967) Photoallergy to sandalwood oil. *Archives of Dermatology*, **96**, 62.
- STEINBRINCK, W. (1950) Besondere Beobachtungen an allergischen Krankheiten. *Zeitschrift für die gesamte innere Medizin*, **5**, 311.
- STEINER, S.D. & SCHWARTZ, L. (1944) Dermatitis from mahogany wood (*Swietenia macrophylla*). *Industrial Medicine*, **13**, 234.
- STEP, E. (1904) *Wayside and woodland trees*. Warne, London & N.Y.

- STERN, E. (1891) Ueber einige Hautkrankheiten der Musiker. *Münchener medizinische Wochenschrift*, **38**, 739.
- STERNBERG, M. (1908) Aus dem Gebiete der Berufskrankheiten. *Medizinische Klinik*, **14**, 479.
- STEWART, C.D. (1940) Dermatitis due to Mesquite wood. *Archives of Dermatology and Syphilology*, **42**, 937.
- STIER, R.F.E. (1929) discussing BLACK (1929). *Journal of Allergy*, **1**, 88.
- STONE, H. (1921) *A textbook of wood*. Rider, London.
- STONE, H. (1924) *The timbers of commerce*. Rider, London.
- SUBIZA, E. (1958) Pseudo allergia por maderas tropicales. *Medicina y seguridad del trabajo*, **6**, 74.
- SUBIZA MARTÍN, E. (1971) Etudes expérimentales avec le bois d'Oukola (*Dumoria africana*). *Les Bronches* (Paris), **21**, 517.
- SUSKIND, R.R. (1967) Dermatitis in the forest product industries. *Archives of Environmental Health*, **15**, 322.
- SYMANSKI, H.J. (1957) Opticusatrophie nach Verarbeitung von exotischen Hölzern? *Medizinische Klinik*, **52**, 198.
- TAN, K.S. & MITCHELL, J.C. (1968) Patch and photopatch tests in contact dermatitis and photodermatitis. *Canadian Medical Association Journal*, **98**, 252.
- TENCHIO, F. (1948) Etiologie de l'eczéma des bûcherons. *Dermatologica*, **97**, 72.
- THIENEMANN, K. (1941) Kambala-Teakholz-Dermatosen. *Archiv für Dermatologie und Syphilis*, **182**, 551.
- THOMPSON, W.G. (1914) *The occupational diseases*. Appleton, N.Y.
- TIMBER DEVELOPMENT ASSOCIATION (1963/4) Personal communication.
- TITMUSS, F.H. (1965) *Commercial timbers of the world*, 3rd edn. Technical Press, London.
- TOMMASI, L. (1929) Dermite dei boscaioli de ipersensibilità. *Giornale italiano di Dermatologia*, **70**, 1223.
- TOTTIE, M. (1938) Jacaranda als Ursache von Dermatitis. *Acta dermato-venereologica*, **19**, 235.
- TOURAINÉ & BERNOU (1932) Recherches expérimentales sur la dermatite du bois de 'Peroba amarella'. *Bulletin de la Société française de Dermatologie et de Syphiligraphie*, **39**, 1396.
- TOURAINÉ & GOLÉ (1934) Les dermatites par bois toxiques. *Paris médical*, **91**, 62.
- TOURAINÉ, HESSE, J. & GOLÉ (1932) Vingt cas de dermatite par bois satiné ('Peroba grande amarella'). *Bulletin de la Société française de Dermatologie et de Syphiligraphie*, **39**, 1392.
- TOURAINÉ, A., MÉNÉTRÉL, B. & JOUENNE, M. (1934) Dermatite eczémateuse du palissandre. *Bulletin de la Société française de Dermatologie et de Syphiligraphie*, **41**, 1969.
- TOUTON, K. (1932) Hauterkrankungen durch phanerogamische Pflanzen und ihre Produkte. In: *Handbuch der Haut- und Geschlechtskrankheiten* (Ed by J.Jadassohn), Vol 4/1, pp. 678-697 (woods). Springer, Berlin.
- TOYAMA, I. (1918) Rhus dermatitis. *Journal of cutaneous Diseases*, **36**, 157.
- TROUSSEAU, A. (1886) La conjonctivite chrysophanique. *Annales de Dermatologie et de Syphiligraphie* (2nd series), **7**, 275.
- TURC, H., BRUNEL, R. & TOLOT, F. (1950) Accidents allergiques dus au bois de Makoré. *Archives des Maladies Professionnelles*, **11**, 490.
- VALLANDER, A. (1950) The effect of wood dust on the lungs. *Nordisk Medizin*, **44**, 1315.
- VOLK, R. (1911) Das Überempfindlichkeitsproblem in der Dermatologie. *Archiv für Dermatologie und Syphilis*, **109**, 163.
- VONKENNEL (1929) Teakholzdermatitis. *Zentralblatt für Haut- und Geschlechtskrankheiten*, **30**, 691.
- VORREITER, L. (1949) *Holztechnologisches Handbuch*. Fromme, Wien (later edition 1958).
- WAGENFÜHR, R. (1961) Gibt es giftige Hölzer? *Möbel und Wohnraum*, **4**, 120.
- WALKER, I.C. (1921) Bronchial asthma. In: *The Oxford Medicine* (Ed. by H.A.Christian), Vol. 2, p. 231. Oxford (1921-1947, loose-leaf).
- WATT, J.M. & BREYER-BRANDWIJK, M.G. (1962) *The medicinal and poisonous plants of southern and eastern Africa*, 2nd edn. Livingstone, London.
- WEBB, L.J. (1948a) Guide to the medicinal and poisonous plants of Queensland. *Commonwealth Scientific and Industrial Research Bulletin* no. 232, Melbourne.
- WEBB, L.J. (1948b) The blistering alkaloid in 'poison walnut' (*Cryptocarya pleurosperma* Wh. & Fr.). *CSIR Forest Products News Letter* no. 169.
- WEBER, L.F. (1930) A list of cutaneous irritants. *Archives of Dermatology and Syphilology*, **21**, 761.
- WEBER, L.F. (1953) Dermatitis venenata due to native woods. *Archives of Dermatology and Syphilology*, **67**, 388.
- WEBSTER (1911) *New International Dictionary*. Merriam, Springfield.
- WEBSTER, A.D. (1920) *London Trees*. Swarthmore, London.
- WECHSELMANN (1909) Ueber Satinholzdermatitis, eine Anaphylaxie der Haut. *Deutsche medizinische Wochenschrift*, **35**, 1389.
- WEHRLI, W., SCHINDLER, O. & REICHSTEIN, T. (1962) Die Glykoside des Milchsafes von *Antiaris toxicaria* Lesch. aus Malaya sowie von *A. africana* Engl. aus Kenya. *Helvetica Chimica Acta*, **45**, 1183.
- WEITBRECHT, U. (1967) Allergie gegen Bethabara-Holz. *Berufsdermatosen*, **15**, 183.

- WENDORFF, G.VON (1964) Personal communications. (Department of Federal Forest Research, Ibadan, Nigeria.)
- WHITE, J.C. (1887) *Dermatitis venenata*. Cupples and Hurd, Boston.
- WHITE, J.C. (1889) Some unusual forms of dermatitis venenata. *Boston medico-surgical Journal*, **121**, 583.
- WHITE, J.C. (1903) Dermatitis venenata—a supplemental list. *Journal of cutaneous Diseases including Syphilis*, **21**, 441.
- WHITE, R.P. (1920) *Occupational affection of the skin*, 2nd edn. Lewis, London.
- WIESNER, J. (1903) *Die Rohstoffe des Pflanzenreiches*, 2nd edn. Engelmann, Leipzig.
- WILKINSON, D.S. (1970) Dermatitis from Khaya mahoganies in the furniture industry. *Atti del Symposium sulla prevenzione delle dermatosi professionali* held at Monte Porzio Catone, 25/26 May 1970.
- WILKINSON, D.S. (1971/3) Personal communications.
- WINKLER, A. (1956) Dermatitis durch Pappelharz. *Dermatologische Wochenschrift*, **133**, 81.
- WODEHOUSE, R.P. (1971) *Hayfever Plants*, 2nd edn. Hafner, N.Y.
- WOOD, R.F. (1957) Robinia. In: *Exotic Forest Trees in Great Britain*, p. 164. Forestry Commission Bulletin no. 30 HMSO, London.
- WOODS, B. (1962) Irritant plants. *Transactions of the St John's Hospital Dermatological Society*, **48**, 75.
- WOODS, B. (1964) Unpublished survey of sawmills and woodworking factories in Ibadan, Nigeria.
- WOODS, R.P. (1951) *Timbers of South America*, 2nd edn. Timber Development Association Ltd., London.
- WOOLSTON, A. & PHILLIPS, E.J. (1955) Utilization of some of the woods in Alto Paraguay. *Tropical Woods*, **102**, 23.
- YOSHIDA, H. (1884) Lacquer (*urushi*). Description, cultivation, and treatment of the tree, the chemistry of its juice, and its industrial applications. In: *Forestry and Forest Products* (Ed. by Rattray and Mill). Douglas, Edinburgh.
- YOUNG, T.F. (1902) See OLIVER (1908).
- YULE, H. & BURNELL, A.C. (1903) *Hobson-Jobson*, a glossary of Anglo-Indian (New edn. by W.Crooke). Re-issued 1968. Routledge, London.
- ZAFIROPOULO, A., AUDIBERT, L. & CHARPIN, J. (1968) Les accidents provoqués par la manipulation des bois exotiques. *Folia allergologica*, **15**, 396.
- ZAVARIN, E., SMITH, R.M. & ANDERSON, A.B. (1959) Paper chromatography of the tropolones of Cupressaceae II. *Journal of Organic Chemistry*, **24**, 1318.
- ZSCHUNKE, E. (1963) Krankheiten durch den Umgang mit Holz. *Holztechnologie*, **4**, 51.

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