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Aboriginal Fish Poisons

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PREFACE

The aboriginal use of poisons is a rather neglected field of research,[1] a situation somewhat surprising in view of the abundance of data bearing on native uses of toxic substances. There has been, for example, no general study of North American arrow poisons, yet our ethnographic literature constantly refers to their use and identification.[2] The larger study of ethnobotany, of which ethnotoxicology is a component, has for long been a subject of interest, and we have many good works dealing with native utilization of plants. It is a specialists' field, however, and only rarely does an ethnobotanist have the requisite anthropological background and insight to produce a work which satisfies competent students in both fields.[3] It is for this same reason that I am somewhat reluctant, as a nonspecialist in botany and toxicology, to offer this study. But since we lack any general statements whatsoever on the subject of fish drugging, it is felt that what is offered here will be useful in view of the lack of any other general review. In dealing with piscicides the cultural rather than the purely botanical or toxicological aspects of the data have been emphasized.[4]

There is, in the present study, no attempt at presenting any theoretical thesis. It is hoped, however, that the data contained herein will show by themselves certain facets of primitive thought and psychology. Few today would deny the existence of logical thought on the part of preliterates and still claim seriously that "prelogical" thought (in the sense of Lévy-Bruhl) is the only form of thinking which determines primitives' actions and reactions. Both types of mental process do exist, and they are useful concepts serving as interpretative tools. I feel that the present data on piscicides show the essentially matter-of-fact, logical, cause-and-effect type of human thought as applied to that fundamental urge, the food quest.

[1] Lewin (1923) has specialized, as a toxicologist, on arrow poisons.

[2] A start, but always from a regional standpoint, on this problem has been made. See, for example: Hoffman, 1891, 1896, p. 284 ff.; Beals, 1932, table 89; Spier, 1928, p. 259; Birket-Smith and de Laguna, 1938, p. 465; Heizer, 1938, 1943.

[3] Vestal and Schultes' (1939) Kiowa economic botany is one of these exceptions, as are the numerous works of Volney H. Jones of the University of Michigan. For a stimulating view on specialized aspects of the relation between man and plants, see Sauer (1947).

[4] For botanical and toxicological data on plants and plant toxins employed in fish drugging, see Greshoff, I (1893), II (1900), III (1913), 1909; Radlkofer, 1887; Ernst, 1881, 1888 a, 1888 b; Howes, 1930: Maiden, 1894; Killip and Smith, 1931; Hamlyn-Harris and Smith, 1916; Vellard, 1941; Priess, 1911; Gillin, 1936, pp. 12–13; Roark, 1936, pp. 27–38; 1938, pp. 25–37.

The procedure followed here is the simple one of presenting the collected data in tabular form, translating these items into a cartographic representation (map 2), then discussing these raw data at some length in interpretative sections as to possible origins, analysis of distributions, and probable history of the complex. The discussion progressively leaves in its wake a series of unsolved problems. Inconclusiveness need not signify insolubility; it is merely that the major problem of presenting the mass of data seems most important at this time.

This study had its origins in the subject of fish drugging in California, the data being derived from the new and extensive Culture Element Distributions Studies of the Department of Anthropology of the University of California. A summary of the Californian data is presented in the proper place, the abundance of data from other regions in the world making the former seem inadequate as a springboard from which to proceed to the larger considerations connected with fish poisoning in general.

I should like to express my indebtedness to Dr. A. L. Kroeber for his suggestion that I enlarge the earlier study to its present amplitude. to my colleagues, Dr. T. D. McCown and Dr. R. H. Lowie for several long and helpful talks on the subject. Dr. C. O. Sauer has also aided me, and I here express my appreciation for his encouragement.

I am particularly indebted to Dr. Harold St. John, of the Department of Botany, University of Hawaii, and Dr. E. P. Killip, of the Smithsonian Institution, who performed the difficult task of checking and revising the botanical names in the tables.

ABORIGINAL FISH POISONS

By Robert F. Heizer

INTRODUCTION

METHODS OF EMPLOYING PISCICIDES

The universal feature of fish stupefying is simply the recognition of a narcotizing, sometimes lethal, effect on the fish by introducing the poisonous principle of a plant into the water. An effective plant piscicide must fulfill certain conditions, among which are great solubility, rapid diffusion in the water, high potency so that it is effective in dilute solutions, and it must have such an effect that the fish itself does not have a toxic quality when eaten by humans. The techniques are somewhat varied, and are classified as follows:

(1) *Dumping crushed plant materials into the water.*—This is the most common method; universally present within the area shown on map 2 where piscicides are employed. Plant materials (roots, leaves, fruit, seeds, or whole plant) and tree saps are crushed or otherwise extracted and put into the water. The limiting condition here seems to be in the location selected; either a pool, or slow-moving stream. Sometimes this is artificially formed by a rock or brush dam (weir). At any rate, very large bodies of water (rivers, lakes, tidal lagoons) would ordinarily allow too much dilution or dispersal of the poisonous juices, as would also be the case in a small, rapidly flowing stream. Thus, the area to be poisoned must be amenable to fairly intensive and restricted action by the poison.[5]

(1a) *Sousing crushed plant materials, held in a container, in the water.*—The plant material for fish drugging may be so highly effective that only a little is needed to produce the desired results. In this event, the crushed plants may be put in a bag or openwork basket, soused up and down in the water, and then taken out. This is, of course, a modification of the simpler first method, and is an application best suited to plants of high toxicity. The presence of large amounts of plant toxin might kill all the fish over a very wide area.[6]

[5] Chapple and Coon (1942, p. 158) suggest that "fish poisoning is most common in tropical regions, for warm water is necessary if it is to be effective."

[6] Greshoff (I: 126) notes that the juice of *Euphorbia cotinifolia* L. "is used to kill fish in running water, 1 litre being sufficient to kill all fish in a distance of 1 or 2 miles."

(2) *Poison-bait fishing.*—The actions of various plant toxins differ. Some are stomach poisons; others affect the functioning of the respiratory apparatus of the fish through haemolysis of the red blood corpuscles; still others affect the nervous system. Commonly the toxic principle in plants used as piscicides are found to be saponins (sapotoxins), alkaloids, and glucosides. Some plant toxins act as stomach poisons. In this latter case, the plant may be ground up and mixed with bait into small pellets. These, when thrown into the water and swallowed, soon bring the dead fish floating to the surface.

(3) *Fish poisoning with inorganic chemical substances.*—The use of inorganic chemicals for fish poisoning has not been treated in this paper. Its occurrence should at least be noted. Lime, produced from calcined coral, is used in the western Pacific in the following manner: A water hole or slow-moving stream is selected, lime is thrown in with the immediate effect of killing (*not* narcotizing) all the fish. This is a very wasteful procedure, and is less favored than the use of plant poisons which act as stupefacients.[7] The use of lime in fishing has also been noted for the Nicobar Islands (Whitehead, 1924, p. 99), in ancient Italy,[8] India (Khan, 1930, p. 193), the Malay Peninsula (Anon., 1898, p. 217), France (Anon., 1884, p. 186), and Palestine (Hornell, 1941, p. 127).

(4) "*Fish Smoking.*"—So far as I have been able to determine, this is a fishing method restricted to two Northern Paiute (Paviotso) groups of the Great Basin area of western Nevada. A fire was built near the water's edge and the smoke fanned out over the water; the result being that the fish (brook trout) floated to the surface. It is not clear how this method works, since the plant which was burned is not mentioned.[9]

BOTANICAL LISTS IN THE SOURCES

Ernst, 1881. Fish-poison plants listed under 17 families; pp. 144–146.

Fagundes, 1935. Alphabetical list (by genera) of fish-poison and insecticidal plants; pp. 70–74.

Greshoff I. Alphabetical index of plant families; pp. 176–179. Alphabetical index of genera and species; pp. 180–201. (Italicized names are fish-poison plants).

Greshoff II. Alphabetical index of plant families; pp. 199–204 (includes the plants treated in this work and in Greshoff I (1893), pp. 176–179). Alphabetical index of genera and species; pp. 205–243.

Greshoff III. Alphabetical list of genera and species with the family to which each belongs; pp. 165–179. Alphabetical list of families, genera, species, and folk names of all plants treated in Greshoff I, II, III; pp. 181–370.

[7] Hamlyn-Harris and Smith, 1916, p. 2 (Solomon Islands).

[8] Pliny the Elder (Natural History, Book 25, ch. 54) cited by Hamlyn-Harris and Smith, 1916, p. 2; Butler, 1930, pp. 150–151.

[9] Stewart, 1941, element 293a, note p. 426.

Hamlyn-Harris and Smith, 1916. Fish-poison plants arranged under 16 orders; pp. 7–22. Classification of fish-poison plants into four groups according to efficiency, p. 7.

Howes, 1930. Index to fish-poison plants arranged alphabetically by genera; pp. 151–153.

Radlkofer, 1887. List of fish-poison plants subsumed under 35 orders; pp. 401–415.

Raizada and Varma, 1937. List of 53 Indian fish-poison plants under 30 families; pp. 204–215.

Vellard, 1941. South American fish-poison plants listed under 11 families; pp. 82–84.

SOURCE LISTS OF GENERA CONTAINING CERTAIN PLANT TOXINS

Cyanophoric: Greshoff II, pp. 21, 71; Greshoff, 1906; Pammel, 1911, pp. 89–90, 53.

Sapotoxin: Greshoff I, pp. 27, 33; Greshoff II, pp. 8, 34; Greshoff III, passim; Hamlyn-Harris and Smith, 1916, p. 7; Pammel, 1911, p. 89; Vellard, 1941, pp. 86–94.

Cumarine: Greshoff II, pp. 11, 92; Greshoff III, pp. 9–10.

Cytisine: Greshoff II, p. 44.

Andrometoxine: Greshoff II, p. 96.

Berberine: Greshoff II, p. 17.

Rotenone: Filho, 1935, pp. 20–21.

For further data, see the special literature: e. g., Allen (1929), Henry (1924).

BIBLIOGRAPHIES IN THE SOURCE ACCOUNTS

Ernst, 1881. In the text of the article, passim; pp. 135–143.

Fagundes, 1935. Bibliography, pp. 74–75.

Greshoff I. Bibliography, pp. 169–170.

Greshoff II. Bibliography, p. 187.

Greshoff III. Bibliography, pp. 163–164.

Hamlyn-Harris and Smith, 1916. Footnotes 1–50, passim.

Howes, 1930. Bibliography, pp. 149–150.

Radlkofer, 1887. Sources listed passim in the text section; pp. 179–401.

Stokes, 1921. Footnotes 1–25, passim, and bibliography, pp. 232–233.

FOLK NAMES OF FISH-POISON PLANTS FOUND IN THE SOURCES

Ernst, 1881, passim, p. 147.

Fagundes, 1935, passim, pp. 70–74.

Filho, 1935, pp. 18–20.

Greshoff I, passim.

Greshoff II, pp. 246–253.

Greshoff III, pp. 181–370.

Hamlyn-Harris and Smith, 1916, pp. 7–22, passim.

Heizer, 1949.

Howes, 1930, pp. 151–153.

Killip and Smith, 1930, pp. 74–77.

Killip and Smith, 1931, passim.

Killip and Smith, 1935, pp. 20–27.

Radlkofer, 1887, pp. 379–401, passim, 415–416.

Vellard, 1941, pp. 81, 82–84.

Roark, 1936, pp. 2–12.

Roark, 1938, pp. 3–10.

THE ORIGINS OF FISH POISONING

The origins of fish drugging are a matter of some theoretical interest. Like most beginnings, however, we are without proof as to place, time, or manner. All we can at present hope to do is to furnish data from which one might infer the manner of origins.

Notwithstanding the fact that the first use of plants as piscicides may have been accidental, their purposive use depends basically upon one principle, namely, the empirical recognition of their toxic properties. To conceive of primitives as slavishly following the custom of pounding certain plant roots, throwing them in the water, and seeing stupefied fish come to the surface, without their having some idea that the plant contained poisonous properties and that the drugged fish resulted from their action, is impossible. In short, the custom among primitive peoples of fish drugging rests on an empirical basis; a definite cause-and-effect relation based on observation is implied.

Greshoff (I, II, III, passim; 1909) gives citations which indicate that primitive peoples the world over recognize and use plants for such purposes as anthelmintics, emetics, narcotics, intoxicants, soaps, insecticides, abortives, antidotes, purgatives, medicines, arrow poisons, vermicides, counterirritants, sedatives, bait poisons, febrifuges, aphrodisiacs, and stimulants. It is well known among certain primitives that animals find certain herbs poisonous. Pastoralists find, particularly among the Leguminosae, plants which poison their stock. It would seem that some empirical observation of poisons would be almost impossible for any native group to avoid. This would be most common on the hunting-fishing rather than a "civilization" level of culture, and generally it is in the former groups that the best practical application of this knowledge for food getting is made.

It is probable that fish stupefying was not invented by coastal people dealing with large bodies of water who gather fish there by mechanical means (i. e., hooks, nets, weirs, or harpoons), but probably by interior peoples who had access to small, quiet streams and to whom fish was probably a subsidiary item of the dietary. No primitive people seem anywhere to follow fish poisoning as a primary economic pursuit—to do so consistently and over a long period of time would exhaust the stream population.[10] It would appear, therefore, to be an addition to a hunting-gathering type of existence. Its position in such a society would, therefore, seem to be that of an auxiliary food-getting technique. Where fish poisoning is a coastal trait, it seems to

[10] This applies more to settled groups, permanently resident on some stream. Wandering, nomadic groups with a seasonal round through a circumscribed, but extensive territory, might not visit a stream in which fish stupefying had been practiced for several months, thus allowing the stream to maintain its population. Cornevin (1887, pp. 425–426, cited by Greshoff I, p. 97) discusses the effect of poisons in killing fish and smaller life forms in water courses.

have come out of the interior.[11] Where it is found on the coast, it is a technique specifically applied to tidal pools (e. g., Oceania); as often as not there (as also on the California coast) it is a means of catching sea life other than fish, such as octopus, shrimp, and crayfish.

Theoretically, the most simple origin of fish drugging would result from the observation of fish eating, or being otherwise affected by, poisonous fruits which fell into a pool from overhanging branches.[12] This is Aristotelian in its logic, simplicity, and, one might add, improbability.

Fish weirs made of branches of poisonous trees or brush might naturally dissolve out toxic substances acting as a stupefacient. This, too, seems only a logical possibility.

Greshoff (I, p. 102) reproduces an interesting statement to the effect that, "The bark [of *Echaltium piscidium* Wight in India] contains a great deal of fibrous matter, used by the natives as a substitute for hemp. In steeping some of the young shoots in a fish pond, in order to hasten the removal of the bark and cleaning the fibers, many, if not all, the fishes were killed." In some such accidental manner as this, natives might be led to recognize the piscicidal qualities of certain plants. A similar example is given by Marsh, Clawson, and Marsh.[13]

The poorer people among the Greeks and Romans and the Cynic philosophers made use of lupine meal in bread. The bitter principle (lupanine, a plant alkaloid) was recognized not only as disagreeable but as injurious, and the seed was especially prepared to get rid of this property. Among the Greeks the seeds were cooked till soft, to remove the outer skin, then placed in sacks in shallow places on the seashore to wash out the bitter principle. Afterward the seeds were dried, ground in a hand mill, and baked into a poor bread.[14]

The use of saponaceous plants for soaps is widely known [15] among primitive peoples. Very commonly, too, sapotoxic plants are used as fish poisons.[16] Thus, using saponaceous plants in water might have the incidental effect of narcotizing fish in the vicinity and thus lead to recognition of their toxic property. However, we do not know whether the use of saponaceous plants for soap preceded the use of

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[11] Note, for example, California, where the great bulk of fish poisoning is interior; in its northward spread it apparently went through the interior instead of along the Oregon coast.

[12] See Swanton, 1931, p. 55. In Mississippi, the "Winter berries" (*Ilex verticillata*) which fall into a stream naturally drive the fish away. E. B. Tylor (1925, p. 213) postulates fish poisoning as originating from branches of toxic plants of trees or poison fruits falling into the water.

[13] 1916, p. 2 (after Landerer). (See also Cornevin, 1887, p. 314, for the same data.)

[14] Water soaking to remove bitter substances is extremely widespread as I have shown in a separate paper on leaching. Mention may be made here of the Californian example of leaching buckeye nuts (*Aesculus*) to remove the cyanophoric content, and also of the fact that buckeye nuts are used as a fish poison. (See Barrett and Gifford, 1933, pp. 148–149, Miwok; Beals, 1933, p. 351, Nisenan; Driver, 1936, p. 187, Wappo; Loeb, 1926, p. 173, Pomo.)

[15] Bibliography of saponin plants in Greshoff III, 1913, p. 9. (See also Rose, 1899, pp. 231–237.)

[16] See Greshoff II, footnote (1), pp. 8–9, for a list of plant families and enclosed genera which are saponin bearing.

sapotoxins as piscicides. I give here only one sample from a number of possible ones. The fruit of *Randia dumetorum* Lam. is used instead of soap by the hill people in many parts of the Himalayas; it is also used as piscicide.[17] This again brings up the question of the natives' recognition of poisons.

Here are a few examples of primitives who recognize plant poisons objectively. The natives of Madagascar say that birds die soon after eating the fruit of *Diospyros toxicaria* Hiern (Greshoff II, p. 103). The Ainu use a decoction of *Picrasma ailanthoides* Planch. bark to kill lice. Should deer eat the bark they soon die—hence the Ainu name of "deer-killing tree" (Batchelor, J., cited by Greshoff II, p. 30). In India the fruit of the *Hydnocarpus wightiana* Bl. occasions giddiness if eaten, and the fruit is greedily devoured by fishes, but fish taken by these means are not fit to be eaten, occasioning in humans vomiting and other violent symptoms.[18] The clearest demonstration of objective recognition of poisonous principles in plants and their effects, both potential and applied, lies in the numerous instances of plants which have several distinct uses, each of which is assignable to the action of the contained toxin. Thus, certain plants commonly serve a multiple purpose as piscicide, arrow poison, narcotic, and vermicide.[19]

THE CULTURAL STATUS OF PISCICIDES

The differential use of certain plants in salt or fresh water seems to have an empirical basis, since the distinction is widely distributed in the Old and New Worlds.[20] The inference here is clearly that certain plant toxins were more effective in fresh water than in salt water and vice versa. Conceptually related would be the observed effect or noneffect of the same poison on certain fish species. For example, the *yarau* fish is said by the Makusi not to be affected by the poisonous juice of *Lonchocarpus*, but succumbs to the action of *Tephrosia toxicaria* (Roth, Walter E., 1924, p. 204). As a further extension of the concept of objective differentiation in the eyes of the native there could be mentioned the selective use of certain parts of plants. The toxic qualities of certain plant roots, fruits, and leaves differ quantitatively—i. e., the poison content is variable. *Diospyros* fruit, *Sebastiana* sap, *Verbascum* seeds, *Aesculus* nuts, and *Phyllanthus* leaves seem to have been consistently and independently selected in widely separated areas—in each case we note that the toxin content is ordinarily higher in the part singled out for use.[21]

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[17] See Greshoff II, p. 34, footnote (1), for a list of saponin-bearing fruits. Greshoff I, p. 42, describes the dual use (piscicide and soap) of *Sapindus saponaria* L.

[18] Greshoff II, p. 21; Greshoff I, pp. 19–20 (Ceylon); Greshoff III, p. 85; Goupil, 1812.

[19] Greshoff I, II, III, passim; Howes, 1930, passim; Hamlyn-Harris and Smith, 1916, pp. 1–6.

[20] Cf. Hamlyn-Harris and Smith, 1916, p. 4 (Australia); Taylor, 1938, p. 145 (Dominica, W. Indies); Hornell, 1941, pp. 126–127 (Palestine).

[21] See the tables in this paper. See also Radlkofer, 1887, passim. Pammel (1911, pp. 82–83) has a discussion of the varying toxicity of different *parts* of plants.

On the other hand, we must recognize that difficulty sometimes arises in distinguishing between real and imaginary (i. e., magical) poisons. In Australia, where witchcraft is linked with the concept of poisoning, this is often the case (Hamlyn-Harris and Smith, 1916, p. 3; Greshoff III, p. 89). A parallel is offered by the Pomo of west central California who conceive of *Angelica* root as a powerful magical substance and extend its conceptual effectiveness to employment as a piscicide.[22] *Angelica* seems never to have been used alone as a piscicide, but was always mixed with some other plant. Therefore, *Angelica* roots might have made the actual poison more effective in the native's eyes. It is possible that an Indian who cast *Angelica* roots alone into the water and observed no results might blame the failure of the poison to act either upon counter-magic which worked against the *Angelica*, or he might have said to himself, "No fish, therefore not a poison." We need further information to judge whether the native would rationalize or justify the noneffectiveness of the *Angelica*, or whether he would give a practical explanation in terms of empirically observed physiological noneffect or effect. It is of interest to note that these innocuous "poisons" are often mixed with actual, proven toxins when employed as piscicides—this would enable the primitive to justify his belief in their effectiveness.

The rational basis of the use of piscicides is again brought out by the fact that we have "composite" fish stupefacients. Although it is clear that magical and actual poisons are sometimes confused,[23] there are numerous instances on record of compounding two or more plants with definite piscicidal properties. These mixtures came about probably as an elaboration in technique; thus, if a group originally knew only a single plant, then tested and used other plants by extension of the idea,[24] they might ultimately wish to combine several stupefacients into a single mixture. This is apparently what has occurred in several places independently.[25]

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[22] Gifford and Kroeber, 1937, p. 320. A similar situation comes to mind with reference to south Alaskan whaling, where magical poisons seem always to have been applied along with a herb poison (root extract of *Aconitum*) to the detachable slate lance head. (See Heizer, 1938, p. 359.)

[23] In addition, all sorts of social customs may impinge on the action of fish poisons. For example, among the Malaya Negritos pregnant females may not accompany a fishing party nor may the fishers mention Malays, blood, jungle leeches, or the private parts of a man or woman, lest poor results attend the venture (Evans, 1937, p. 219). The Guatemalan Chortl use fish poisons only when the moon is in quarter-stage "when the plants are supposed to be most toxic" (Wisdom, 1940, pp. 77–78).

[24] *Asclepias curassivica* L., a native of the West Indies, made its appearance in Queensland about 50 years ago. It was tested and found suitable as a piscicide by the Don River natives. It has been further used as a love charm by the men of the Penney Feather district (Hamlyn-Harris and Smith, 1916, p. 18). This is a provable case of natives testing, observing, and applying a new plant as a piscicide. In Fiji, according to Hornell (1941, pp. 127–128), *Derris malaccensis* Prain was introduced from New Guinea, but is used by the natives as a piscicide.

[25] See, e. g., W. Africa (Tessmann, 1913, pp. 111–112); Siauw (Greshoff II, pp. 180–181); California (Chestnutt, 1902).

That stupefying fish by the use of plant toxins is not an exaggeratedly simple procedure is brought out by the fact that usable plant species are almost invariably more widely distributed than their recorded use as piscicides.[26] Perhaps local custom and the knowledge of several adequate plants in a group's habitat has a sufficient cultural force to offer resistance, or at any rate, lack of interest, in learning of additional plants with piscicidal properties from neighboring groups. This would be a hindering factor to diffusion once the process was known and culturally established in a given habitat. This is only one possible explanation of why people do not use one particular plant which is favored elsewhere.

Certain plants vary in their toxin content according to the time of year. In parts of California, for example, seasonal habitat shifts were reflected in moving to the mountains in summer and to the valley plains in the winter—a high toxin content in summer lowland plants might result in their piscicidal qualities not being recognized [27] or exploited.

Fish narcotizing is, however, a simple enough technique, dependent upon the observation of toxic principles in plants and their physiological effects, so that the possibility of an independent or convergent development seems not unlikely. The origins of the whole technique are obscure, but we can point to certain other parallels in *parts* of the piscicidal complex, aside from the fundamental one of the recognition of toxic properties in plants, which suggest that the mind of primitive man sometimes hits upon the same idea in widely separated areas. In Malaysia [28] and northern South America [29] the plants are put in a canoe, water is added, the plant materials are crushed and the resulting infusion dumped out by overturning the canoe. In both areas this is a community undertaking in the nature of a holiday. Another parallel is that of poison-bait fishing wherein the piscicide often acts as a true stomach poison rather than having a narcotic effect on the respiratory apparatus. The Malayan fish poison, "aker tuba" roots, is ground or pounded into a fine powder and mixed with a stiff clay and crushed refuse, such as shrimps or small fish. This mixture is made into balls, dried, and thrown into the sea like ground bait (Greshoff II, pp. 60-61; III, p. 82). In Guiana (Pomeroon and Moruca River Caribs) *Clibadium asperum* leaves are pounded, mixed

[26] I have investigated the botanical distribution of California fish-drugging plants and find that these plants, in every case, have a much wider natural distribution than that of their cultural (i. e., piscicidal) use (Heizer, 1941, p. 44). Vellard (1941, p. 84) makes the same point for South America. Merrill (1923) found the same to be true in a study of California plant materials used in basketry.

[27] A similar situation referable to the availability of particular plants is mentioned by Hamlyn-Harris and Smith (1916, p. 3) for Australia. (See also Greshoff I, p. 90; Pammel, 1911, pp. 83–85.)

[28] Sumatra (Greshoff II, pp. 49–51); an excellent eyewitness account.

[29] Killip and Smith (1931) present a vivid circumstantial account with numerous photographs. (See also Roth, Walter E., 1924, p. 203.)

with finely cut meat, and made into small balls which are thrown into the water like bait (Roth, Walter E., 1924, pp. 203–204). This technique is also used in Samoa (Buck, 1930, pp. 443–444; Hamlyn-Harris and Smith, 1916, pp. 4–5). A somewhat specialized variant is recorded for the Caribs of Dominica:

. . . a length of caapi (species of ivy) is passed through a bit of raw manioc which is then hung in the water, the other end of the caapi being attached to a rock or stone on the bank. Returning some hours later, usually after dark, the fisherman finds a quantity of stupefied crayfish collected around the manioc, whose poisonous juice has rendered them incapable of flight [Taylor, 1938, p. 145].

Most fish poisons act fairly rapidly, their full effect being arrived at ordinarily within a half hour. Noticeable, then, is the employment of certain plant materials whose action is very slow. I refer here to the use of tannins, whose effectiveness depends on abundance rather than on a small quantity of powerful, quick-acting toxin. The use of plants with a high tannic-acid content has been hit upon both by certain natives of Australia and by the Cocopa of the Lower Colorado River. Tannin has astringent properties which have the physiological effect of interfering with the function of the gills.

Roth describes the Australian procedure as follows:

In the Cloncurry, Woonamurra, and Leichhardt-Selwyn Districts, especially with large water holes, numerous leafy boughs and branches of "gum-tree" (*Eucalyptus microthera* F. Muell.) (Mitakoodi, joo-a-ro) are utilized for a similar purpose. The whole camp of blacks working at it, will start throwing these in the first thing in the morning; during the day the water becomes darker and darker and strongly smelling until by the following morning at sunrise when it is almost black, the fish all lie panting at the surface and are easily caught. [Roth, Walter E., 1897, pp. 95–96. See also, Hamlyn-Harris and Smith, 1916, pp. 6–7, 15.]

Gifford says of the Cocopa: [30] "No true fish poison, but small pond covered with willow (*Salix*) leaves, which discolored water, causing fish to rise in 2 or 3 days."

Just how such plants with slow-acting tanniferous properties came to be applied as piscicides is hard to say. Perhaps the origin lies in observation through accident. It is a relatively uncommon method, however, and mainly of interest here in illustrating a parallel in method in widely separated areas.

The application of plant poisons to water holes for catching game is, of course, widely known among primitive peoples. In a well-watered country there is little chance of catching animals by poisoning water holes. In an arid region where streams are scarce and water holes are important as a source of water for game, such a procedure is an effective one. Thus, it is a commonly known practice in South-

[30] Gifford, 1933, p. 268. See also Gillin 1936, p. 13 (Wa'u poison of British Guiana). Spier (1933, p. 291) notes a rather puzzling case which may refer to piscicides.

west Africa, among North African Arabs, in Australia, Arabia, and the Intermontane Plateau of the western United States southward through northern Mexico. I give two typical citations of this practice from widely separated areas: Beals (1932, p. 103) says the Opata poisoned deer by putting yerba de flecha (*Sebastiana palmeri* Riley) in the water holes. Spencer (1896, p. 52) says the Australians put the leaves and twigs of *Duboisia hopwoodii*[31] in the water hole; emu drink the impregnated water, become dizzy, and are easily killed. This hunting method may or may not be a specialized variant of the use of piscicides, since it is in vogue in some places where fish poisoning is absent.

Howes has emphasized an extremely interesting feature connected with fish drugging—that of aboriginal cultivation of the plants used. This agricultural aspect of piscicides elevates fish drugging from the hunting-fishing stage to the sedentary agricultural level. It is perhaps a technique which has the status of a survival when present among the latter groups.[32] It is possible, since the practice of fish stupefying is essentially a food-getting technique, that farming populations might partly supplant the fish item of the dietary by grains, which would lead to the relinquishment of wholesale fishing. This might obscure (to choose a theoretical unproven example, in Mesopotamia or lower Egypt) the former use of piscicides through dependence on a cultivated-cereal–domesticated-animal-meat diet. Of course, in tropical South America (e. g., in the Guianas), hunting and fishing are important dietary adjuncts to cultivated maize, cassava, etc. There is little doubt that fish drugging is an old cultural feature in South America, and it is logical to suppose that after these tribes learned to cultivate plants (manioc, maize)[33] they extended the technique of planting maize or cassava to certain plants which were used as fish poisons.[34]

Historical data on the introduction of plants offer an interesting sidelight on our problem of placing fish drugging in its proper perspective within the total cultural picture. *Euphorbia tirucalli* L. has been introduced from its homeland in East Africa to West India and

[31] This is the famous *pituri*, the Australian narcotic. Again we see two uses, widely different in the conception of the natives, of the same plant. The *meaning* (i. e., the psychological associations which the plant has to the native user) in terms of attitudes is different in the eyes of the primitive. (See Basedow, 1929, p. 139.)

[32] The question of survival in other areas immediately comes up. In the British Isles fish drugging is a poacher's technique among the "lower classes"—the gentleman's method of fishing is by hook-and-line. If fish stupefying were an old trait, it is among the former we should expect to find it. It is really a means of securing food in quantity—it is not a sport as such, although most primitive peoples seem to have fun doing it.

[33] For a list of cultivated food plants in South America, see Safford (1917, 1927). Nordenskiöld (1920, pp. 168 ff.) indicates that in large parts of South America the cultivation of maize and sweetpotato are fairly recent cultural acquisitions.

[34] The listing and distribution of cultivated plants used for piscicides is too extensive to cite in full. For typical cases, see Howes, 1930, pp. 135, 137 (British Guiana); *Hura crepitans* L. in Mexico (Rose, 1899, p. 257); *Piper methysticum* Forst. in Hawaii (Beckley, 1883, p. 11); Africa (Howes, 1930, p. 133); Killip and Smith, 1931, pp. 403 ff. (tropical South America).

the Moluccas, and has been recognized by the natives as amenable to use as a piscicide (Radlkofer, 1887, p. 413). *Nicotiana tabacum* L. has been selected, among other cultivated plants in eastern India, as a fish stupefacient.[35] This is of interest, for various *Nicotiana* species have been used as piscicides in other parts of the world (Greshoff I, p. 108; II, p. 119; III, pp. 140, 141). It is difficult to see any connection between tobacco smoking or chewing and fish drugging aside from the fact that through smoking or masticating one might recognize in *Nicotiana* certain physiological effects which conceivably could lead to testing the plant for its piscicidal potentialities (cf. Miner, 1939). In all probability, the *Nicotiana* plants were tested along with many others in view of their employment as a piscicide and found useful. Actually, the sedentary hunters and fishers might be expected not to practice fish drugging extensively since the streams in their restricted habitat could thus be easily entirely fished out by consistent application of piscicides. It is a technique better suited to wandering groups of hunters and gatherers, since they would roam over a wider area, in whose streams natural propagation of the fish population would be easily maintained (Greshoff I, II, III, passim; 1909). Although there is much specific data on conservation of fish and game on the primitive level, I know of no primitive people who specifically refuse to practice fish drugging for this reason.[36] It is true, however, that a widely spread primitive recognition of wastefulness that ensues from this method of fishing results in techniques of control.[37]

As different groups throughout the world have experimented with fish poisons, they must have learned that many, while effectively stupefying the fish, at the same time so contaminated the fish that they were not edible (e. g., Greshoff I, pp. 10, 19–20; Bacon, 1906, p. 1026). Such plants would be used only once—ever after to be remembered as a plant to be avoided. Thus most of the recorded fish poisons are not stomach poisons, though they are probably poisonous when injected intravenously.[38] A very clear and quite typical statement as illustration follows:

These saponins (of *Ganophyllum obliquum* Merr.) are particularly advantageous for use as fish poisons, because, whereas many are very poisonous when injected (intravenously), they are usually only slightly so when taken into the stomach

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[35] Ernst, 1881, cited by Radlkofer, 1887, p. 411. Greshoff I, p. 108.

[36] See Howes, 1930, pp. 143, 147–148; Greshoff III, pp. 39, for information on European legislation against the practice of drugging fish. Butler (1930, p. 133) notes a canon of the law from Plato that it "is not forbidden to fish in harbors or in sacred rivers, marshlands, and lakes, provided that he shall not cloud the water with drugs."

[37] E. g., Taylor, 1938, p. 145: "The babarra apples are also crushed, but are enclosed in a basket which is immersed only for the time being, as it would poison the water for almost a week were it left here." The use of excessively potent stupefacients with semipermanent effects might explain the parallel "sousing" technique of applying piscicides in Australia (Roth, quoted by Howes, 1930, p. 145).

[38] I have not thought it necessary to give citations on this aspect of fish drugging—they occur randomly through Greshoff I, II, III, and Howes, 1930.

so that even if the fish is somewhat contaminated with these substances, no harm will come from eating it. [Greshoff III, p. 83.]

While on the subject ot the nature of the effect of piscicides, it is of interest to note that Chestnut recorded from California a native explanation of mechanical, rather than toxicological effects:

> The exact cause of the stupefying or crazing effect [of *Eremocarpus setigerus* (Hook) Benth.] is not known. Some Indians attribute it to the stellate hairs which, they say, attach themselves to the eyes and gills and make them frantic. If these should become thus attached, they would undoubtedly cause great distress, but the chemical qualities of the plant may easily account for the effect. [Chestnut, 1902, p. 366.]

This case throws possible light on native thought, and may be interpreted in this way; Numerous stellate hairs are noticeable on dove weed, for the plant is covered with them like a thick, gray fuzz. But the recorded physiological effects do not necessitate the conclusion that the fish became frantically annoyed—rather, a phytotoxin is indicated. Greshoff (III, p. 231) lists 15 species of *Croton*, a genus related to *Eremocarpus*, used as piscicides, and it is known that *Croton* genus produces a toxalbumin (crotin) which does act as a powerful fish stupefacient. Thus, I am inclined to consider the Indian explanation, in this case, as a rationalization suggested by the presence of the stellate hairs. A similar explanation might arise in the case of stinging nettles, though I have not found any reference to it.[39]

In most cases the toxic plant juices merely have to be freed from the leaves by crushing and soaking. It is, therefore, of interest to note a variation of this simple method which consists of gently roasting the bark or roots in order to partially free the poison principle. Howes [40] states that in Nigeria and the Cameroons the natives half-roast thick pieces of the stem of the climber, *Ophiocaulon cissampeloides* Hook. f., pound them and cast them into the water. The toxic principle is identified as free hydrocyanic acid. In Queensland (Hamlyn-Harris and Smith, 1916, pp. 3, 9) the bark of *Jagera pseudorhus* Radlk. (*Cupania pseudorhus* A. Rich.) is cooked in the native ovens for about half an hour and put in the pond. This genus is listed by Greshoff as cyanophoric. The third parallel, but of a somewhat different nature, is that of the knowledge among the natives of the Amazon region in South America, of driving off the hydrocyanic acid contained in *Manihot esculenta* Crantz (*M. utilissima*) by the application of heat.[41] What is important here is to indicate the parallel in three areas to the effect that heat will free hydrocyanic

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[39] It is of interest to note here that the Chorti Indians of Guatemala say that the plant saps (see table 9) "burn the eyes of the fish causing them to thrust their heads above water to escape the pain" (Wisdom, 1940, pp. 77–78).

[40] 1930, p. 133. See also Hamlyn-Harris and Smith, 1916, p. 20.

[41] A parallel is offered by the Iroquois who roast *Arum triphyllum* roots to free them of their cyanophoric content. (See Parker, 1910, p. 107.)

acid contained in certain plants.[42] Apparently the gentle application of heat serves to disturb and bring out the acid; prolonged heat will free the roots or bark entirely of the poisonous principle.

SIGNIFICANCE OF AREAL DISTRIBUTIONS

AUSTRALIA

Hamlyn-Harris and Smith [43] have outlined the Australian ocurrences of fish poisoning as generally distributed with the exception of the arid regions of central and south Australia. The most intensive use definitely centers in northeastern Australia (specifically Queensland). These authors have performed experimental tests with fish-poison plants [44] and have arrived at the following classification of plants according to their efficiency:

Group A.—Effective and rapid in action at great dilution: *Derris*, *Tephrosia*, *Pongamia*, "*Nero*," containing active principles associated with ether-soluble resins; the sapotoxin-containing *Careya*, *Cupania*, *Faradaya*, *Garcinia*.

Group B.—Poisons of intermediate effect: *Barringtonia speciosa*, *Stephania hernandiaefolia*—alkaloid-containing.

Group C.—Poisons of lesser effect, slow in action at higher concentrations or uncertain in action: *Acacia*, *Albizzia*, *Eucalyptus*, *Thespesia*, *Terminalia*, *Polygonum*.

Group D.—Reputed poisons, found innocuous: *Sarcocephalus*, *Pleiogynium*, *Petalostigma*, *Alocasia*, *Asclepias* (?).

As to whether the use of piscicides in Australia is due to independent development or to diffusion from outside is a difficult question to decide. Hamlyn-Harris and Smith say:

> The possibility of the introduction of the custom from such quarter (Malaysia or Melanesia) must be judged on general grounds and by the standard of recognized external influence upon aboriginal customs.
>
> Considering the universality of fish-poisoning it is not unjustifiable to assume an independent origin among the Australian aborigines, and the evolution of an empirical knowledge of efficient piscicides. [Hamlyn-Harris and Smith, 1916, pp. 2–3.] [45]

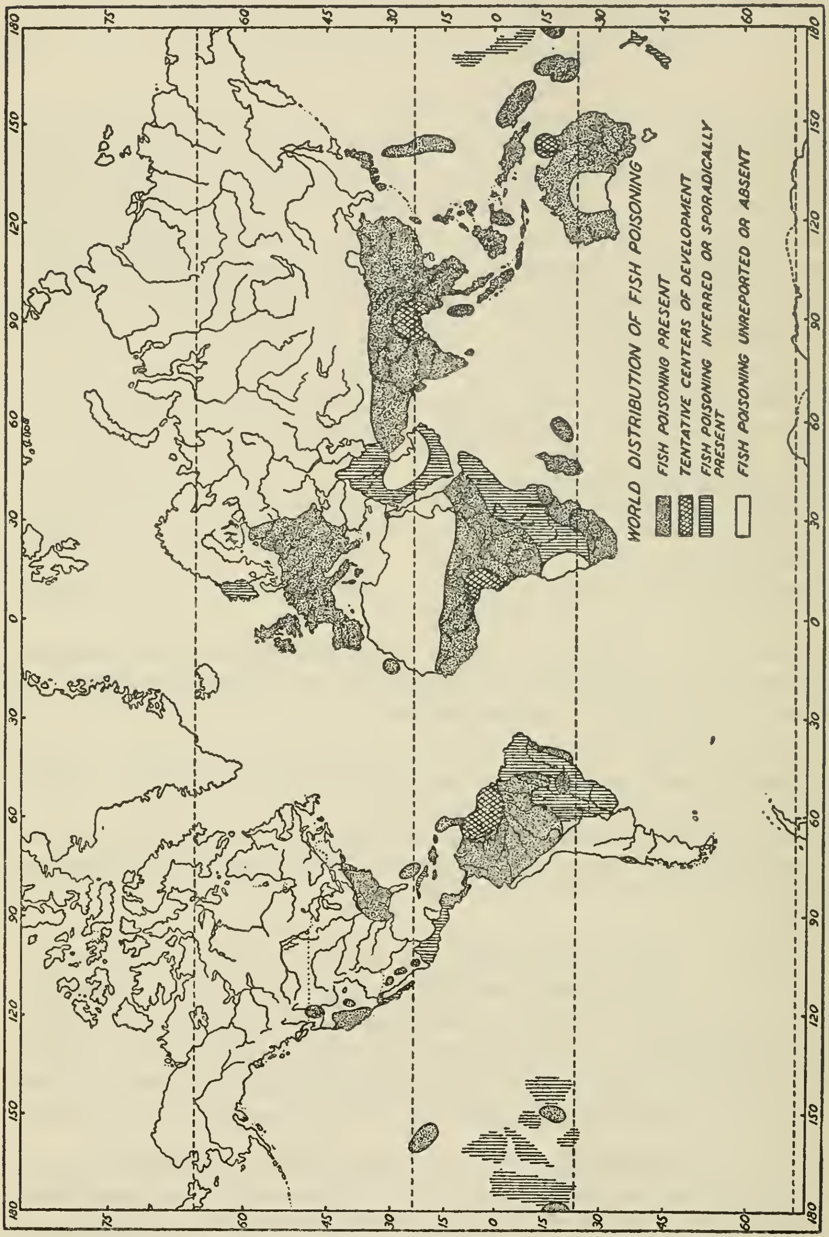
Two facts must be noted which have a bearing upon this conclusion. The first is the continuous Australian distribution of fish drugging; the second is the decided emphasis on fish stupefying in the region adjoining Melanesia, the same area in which, in other aspects of culture, the most pronounced external cultural influence has been received, viz, Queensland. I offer here an alternative theory to that

[42] There is a discussion along the lines suggested here in my separate study of leaching plant foods.

[43] 1916, pp. 1–22 (a general discussion of Australian fish drugging). This paper, with that of Maiden's (1894) covers the subject quite adequately. Both contain bibliographic data on local groups. Howes (1930, pp. 142–146) has a general discussion of Australian piscicides which includes some new data.

[44] All but the most general statements in reference to the pharmacological effects of piscicides are avoided here, since there are published data on this aspect (Greshoff I, II, III; Howes, 1930; Hamlyn-Harris and Smith, 1916; Hanriot, 1907; Greshoff, 1898; van Hasselt, 1910).

[45] Howes, 1930, p. 142, occurs in this conclusion.



Map 2.—World distribution of fish poisoning.

proposed by Hamlyn-Harris and Smith. The concept of fish drugging may have entered Australia ultimately from Southeast Asia via Malaysia and western Melanesia. It was first received by the Queensland natives on Cape York Peninsula, where the center of development is noted. From there fish poisoning diffused through Australia wherever it was environmentally acceptable.[46] It did not reach Tasmania. In the present discussion we have repeatedly seen that the Australians exercised ingenuity in regard to the application of fish stupefacients. This leads to the conclusion that the Australian evolution, i. e., the further development of piscicides aside from the original introduction, was autochthonous and had little or no relation to historical developments outside Australia. This is the only logical inference, since it is impossible to conceive of the Australians accepting from outside sources their every technique of preparation and application of the many plants used as piscicides.

SOUTHERN ASIA AND MALAYSIA

It is difficult to draw hard-and-fast geographical boundaries and discuss the use of piscicides within such areas for the reason that such distinctions are arbitrary and do not delimit areas in which fish poisons are used—they are geographical labels which give us a starting point for discussion.

A great block of near-universal application of piscicides appears on map 2. This runs from Persia in the west to North China on the east and southward from this line to include India, Burma, and the Malay Peninsula. Eastern India and Burma seem to be the climax area of this defined distribution. The obvious extensions are into the Indian Ocean to include Ceylon, the Andaman and Nicobar Islands, the great Malaysian islands (Sumatra, Borneo, Java, Celebes), and the islands to the north (the Philippines, Formosa, and Japan). This whole great area is, in a great many ways, composed of a series of historically related units—separate histories have occurred, but in no single case have they been entirely independent of that of their neighbors. Thus, when we find a commonly distributed element of culture, we immediately suspect historical causes (i. e., diffusion) as an explanation.

OCEANIA

This area, in a geographical sense, includes the three great cultural areas of the Pacific island world—Polynesia, Micronesia, and Melanesia.

It appears from the sources consulted that piscicides are generally

[46] This hypothesis is compatible with other historical deductions formed on the basis of geographical distribution. (See Davidson, 1936, and Warner, 1932, for studies of this type.)

distributed throughout this whole great island area.[47] They occur in Hawaii, the Caroline and Marianas Islands, the Solomon Islands, and New Guinea,[48] to name typical places of each culture area (see table 2 for fuller occurrences). Fresh-water streams or tidal pools would be the best-suited places for fish drugging. Where piscicides are not used in the area the possible explanations of absence may be several. Piscicides may once have been known and subsequently given up in favor of netting, spearing, or hook-and-line techniques. Or the environment itself may be at fault in offering no convenient places to narcotize fish. Although the use of kava in Hawaii as a bait poison for sharks is included under our broad classification of fish drugging, it actually is not a stupefying technique as such, but is perhaps related in concept to the whole use of bait poisons.

Oceania, as defined here, is an area with a relatively continuous distribution of the use of piscicides. Knowing as we do the great importance diffusion has played in the formation of these various insular cultures, there is strongly suggested the possibility that Oceanian occurrences of piscicides are due to diffusion[49] and that Oceanian fish drugging is a historical entity, its ultimate origin being Asiatic.

AFRICA

Piscicides are in general use throughout Africa with the exception of the Sahara and Kalahari Desert regions. The blank area of British and Italian Somaliland may be misleading, since there is no information at all on the possible presence or absence of the complex in that area. At best, however, these territories are arid and hardly constitute a locale where one would expect to find piscicides in common use.

The area of greatest elaboration (i. e., techniques of application and diversity of plants used) seems definitely to be in West Africa in the Cameroons–French Equatorial Africa–Belgian Congo region.

Plants used for fish drugging are often cultivated in Africa. This leads to the inference that we are dealing with a very old trait in certain agricultural groups.[50] The parallel with South America is

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[47] For general data, see Stokes, 1921.

[48] Hamlyn-Harris and Smith (1916, pp. 1–2), who knew of no fish poisoning in New Zealand, attempted to explain the nonoccurrence as possibly due to the presence of boats and fishing gear by an expert fishing people. However, this does not hold for the rest of our large area, so there must be some other explanation. I have found only one reference to fish drugging (with *Lepidium oleraceum* Forst.) in New Zealand (Radlkofer, 1887, p. 402). Fish drugging is apparently uncommon, however, and as a possible explanation I submit the theory that the Maori colonizers of New Zealand did not find suitable plants in their new habitat, or they lacked interest in testing new plants because their other means of fishing were sufficient for their needs. I do not think this problem concerning New Zealand can be answered in general terms—the answer lies probably in specific facts which we do not have on record.

[49] Cf. the words for fish poisoning: In Rarotonga (Cook Islands) it is *hora*; in Hawaii the word is *hola*.

[50] "*Mundulea suberosa* (DC) Benth . . . probably as a result of age-long cultivation has now a very wide range" (Howes, 1930, p. 133).

treated elsewhere. What is of interest is the implication it has as to the cultural position of such groups who practice both agriculture and fish drugging. We may infer that these people live in regions suitable to the use of piscicides, that they do not limit their dietary to cultivated foods, but are interested in supplementing it with products of the chase. It drives home the point that settled farmers may practice techniques of food getting which we ordinarily think of as restricted to more primitive culture levels—and the techniques have undergone modification at the hands of the farmers.

Madagascar has experienced profound cultural influence from the Malaysian area. The presence of piscicides here may either be due to an Asiatic source, or be derived from the African mainland. The use of piscicides on the Cape Verde and Canary Islands and Madeira is perhaps, though not certainly, ascribable to recent Spanish or Portuguese influence. At any rate, the intra-African occurrences of fish poisoning seem to be continuous and may be, ipso facto, historically connected. There is no concrete evidence of origins in Africa, but (aside from the relatively recent Portuguese and Indonesian connecting links with extra-African cultural areas) the distribution (map 2) suggests the possibility of an independent African origin of fish drugging. Unless we weigh the other possibilities, however, a decision will be hard to reach. Could the use of piscicides have been an ancient, now-forgotten, custom along the lower Nile? [51] Could it have once been connected through coastal Arabia with Persia and India? There are too many possibilities of this kind to allow us a definite opinion. African fish poisoning may be a tropical West African invention, later diffused generally throughout the continent. Or it may have been anciently related to the Euro-Asian occurrences, the former intermediate links not now being in evidence.[52] It is ever hazardous to postulate the loss of simple, uncomplex useful arts in the absence of some concrete proof.[53]

The possibility of independent invention of fish poisoning would seem to be ever present, and in the total absence of archeological

[51] Bates' (1917) exhaustive treatment of ancient Egyptian fishing contains no mention of piscicides. Radcliffe (1921, p. 318) says there is no evidence for Egyptian fish poisoning.

[52] The Sahara Desert region was, as recently as Late Paleolithic and even Mesolithic times, better watered and more fertile. If fish drugging were then present in the Saharan region, we might suspect a connection with Europe (especially Spain and France) which was broken with the advent of the desiccation of North Africa, and with Asia owing to the same phenomenon in Syria-Arabia. (See Childe, 1934, pp. 23–26; Wulsin, 1941, pp. 4–7). Radcliffe (1921, p. 358) after an exhaustive review of the data, concludes the Assyrians did not use poison in fishing.

[53] This theorem holds more for nonmaterial culture which archeology may hardly hope to throw light upon. For example, Killip and Smith (1931, p. 407) say, "At Manaos all agreed that the Indians of the upper Rio Negro and the Rio Branco used plants almost exclusively for fishing." Tessmann (1930, p. 300) states that the Ssabela of northeastern Peru fish only with plant poisons and deny using nets, hooks, or spears. (See also Radcliffe, 1921, p. 318.)

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evidence of fish drugging, we are not on very firm ground in attempting to solve the particular question concerning African piscicides. It is all too easy to elaborate on a concept after it is known; it is harder to formulate that concept for the first time. Logically, then, we might expect that the presence of fish poisoning would be more often due to historical transmission than to independent invention. The probabilities are theoretically enhanced when we have continuous distributions of single occurrences. Thus, African piscicides would seem to be a related unit, but the question of ultimate origin remains open, as shown above, to at least two possibilities.

It is theoretically probable that the concept of fish poisoning might spread rather easily and quite rapidly. It is a simple, functional complex which would find ready acceptance [54] because (1) people already know the plants in their own environment which might be applied as piscicides, and (2) it is an uncomplex subsistence technique which yields results with a minimum of labor; in short, it is easy and eminently useful.[55] Then too, primitive groups are liable to come into close contact along waterways and there see and learn about piscicidal techniques.

EUROPE

Fish drugging is apparently a very old practice in Europe. Perhaps the earliest literary reference occurs in Aristotle's Historia Animalium, wherein is mentioned the use of a plant (*Verbascum*) for killing fish. Pliny also notes a plant, probably an *Aristolochia* species, used for drugging fish in Italy (Ernst, 1881, p. 136; Greshoff I, pp. 117–118). Dioscorides notes plants for stupefying fish. For further information on Greek, Roman, and Phoenician fish poisoning, the reader is referred

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[54] I would emphasize this point of the uncomplex nature of the technique of fish stupefying, since it has a direct bearing on the "diffusibility" of the practice. A trait or complex cannot be easily accepted into a new culture unless the accepting group's culture finds a favorable niche for it. Notwithstanding a possible use or need for it, the culture must be somewhat amenable in order for it to become an integrated feature—otherwise it appears as an excrescence and is likely to be dropped since it is at variance with the rest of the culture-whole.

An illustrative example comes to mind. Whaling, on the northwest coast and in the Aleutian Islands was an important subsistence feature allowing a man to become wealthy and therefore to enjoy high social standing if he controlled the techniques. But whaling was surrounded with secrecy and excessively dangerous (to the uninitiated) ceremonial preparations. It is not hard to see how the whaling complex might have a low index of diffusibility, since the prerogatives of whalers were jealously guarded secrets, and a whale hunter had a decided economic advantage. Whaling in at least part of this area does seem like an excrescence, since it is a monopoly held only by a few individuals; but at the same time, a whale helps the whole community to eat. A complex of this sort, in order to diffuse, must do so by direct contact and personal instruction; fish stupefying, on the other hand, could spread by stimulus diffusion from group to group whose contacts were of the most tenuous sort.

[55] There is some warrant for believing that food-getting techniques or means may spread very widely—note the extensive distribution of maize; the metate; lye-hulling of corn; or hunting techniques such as the impound; or fishweirs. These are found in widely divergent types of culture.

to table 3, and to the special literature.[56] Early European herbals, statutes, plant lists, and pharmacopoeias have all contributed to the knowledge of piscicides in this area.[57] At a very early date, however, laws against fish drugging were instituted [58] and this enlightened attitude toward fish conservation has probably resulted in its being relinquished as a commonly shared culture trait among nearly all European peoples who once practiced it.[59]

Table 3 gives numerous European occurrences of fish narcotizing.[60] There is not much to discuss, since many of the data are generalized. Clear and specific mentions of piscicides in Asia Minor (Turkey), Persia, or the Caucasus region are rare. The first two areas have large stretches of desert with few fish. If these apparent gaps could be explained away as due to environmental causes, the southern Asiatic piscicide area could be joined to that of Europe and we might relate the whole Euro-Asian occurrences into a grand unit. Until this is proven, however, we shall have to consider the possibility of Europe as a separate area of fish drugging. Northern Europe seems to have had little or no use for piscicides.[61]

NORTH AMERICA

This cannot be considered, a priori, as a separate area, since it connects with South America through Middle America and the

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[56] See Mair's translation of Oppian's Halieutica (Oppian, 1928, Book IV, lines 648 ff. and ftns. a, b, pp. 452–453); Badham, 1854, p. 21; Butler, 1930, pp. 133, 150–51; Radcliffe, 1921, pp. 239–240; Aristotle, 1883, Book VIII, ch. XX, p. 220 (Cresswell translation). These give detailed data on the use of various piscicides (*Verbascum*, *Cyclamen*, *Aristolochia*). There is a possibility, judging from somewhat imperfect evidence, that the Greeks used wine for fish drugging (Butler, 1930, pp. 149–150; Radcliffe, 1921, p. 239, illustration of a mosaic from Melos, pl. opp. p. 240).

[57] Howes, 1930, p. 147, cites Ficalho, who notes a law of 1565 against poisoning fish with plant materials or chalk. This reference to chalk (presumably finely divided like our plaster-of-paris) may refer to lime or it may indicate the use of a "mechanical" piscicide which clogs the gills and suffocates the fish. As late as 1884 there is a mention of the use of lime in securing fish in France (Anon., 1884, p. 186).

[58] Ernst, 1881, p. 136; Greshoff II, p. 162. Frederick II in 1212 prohibited the use of *Taxus* and similar plants in poisoning fish in the Kingdom of Sicily.

[59] I have already suggested (note 32, p. 240) that the use of this method by poachers in the British Isles or on the continent may be a survival, the tradition being maintained among the common people as a means of securing food, while legislation and custom made it impossible for a gentleman to indulge in the practice (Kirby, 1933). The "gentleman" is the man who already has enough to eat—he has leisure to read in Izaak Walton's The Compleat Angler the "correct" method for angling. In other words, here is a survival among the lower classes of a technique which has persisted through need and maintained its function, viz, food getting. On the other hand, the function of angling (which we assume supplanted fish drugging) among the leisure or upper class has changed. Although the fish thus secured *may* be used for food, the primary function has become one of sport. It is not an uncommon end for utilitarian techniques or objects to become of sporting interest among the upper classes. Examples are not difficult to think of—archery, falconry, and game hunting come immediately to mind. In this way, cultural degenerations (i. e., survivals due to the process of what Rivers called the "disappearance of useful arts") are of value in exhibiting cultural processes; they are signposts of culture change. They may often have an irrational basis, another example of the importance of nonutilitarian motives which have been indicated as factors of culture process elsewhere in this paper.

[60] See Howes, 1930, pp. 146–149, for a discussion of European fish poisoning.

[61] There is a single, rather doubtful reference to the use of *Hyascamus niger* L. as a fish poison by the Norwegians (Janus, vol. 10, p. 600, 1905).

Antilles. Despite this general continuity it will be worth while to examine what seem to be the foci of fish drugging in the New World.

CALIFORNIA

Map 2 shows the cartographic position of California piscicides in relation to the world-wide distribution. Map 3 gives the general distribution, in terms of presence or absence, of fish poisoning and fish smoking in the western United States. On the basis of numbers of plants used, I have suggested two centers of development or elaboration. The first includes the Pomo area, where four plants (manroot, turkey, mullein, soaproot, and buckeye) [62] are used. The second center is among the southern Yokuts, where again four plants (buckeye, pepperwood, soaproot, and turkey mullein) are used.

Map 4 gives the main plant forms employed in fish narcotizing, and is based solely on the University of California Culture Element Distribution series.[63] I have omitted plotting on map 4 certain minor or rare occurrences of plants which are listed below.[64]

A comparison of the natural distribution of 12 individual plant species (Jepson, 1925) with the distribution of their cultural use clearly indicates that there is a differential of natural occurrence and cultural utilization, the former being the wider, the latter more restricted. The implication is of possible general significance, particularly in view of parallel examples, in demonstrating that the efficient utilization of the external environment depends on "cultural recognition" of the utilitarian possibilities of what nature offers.[65]

Except in the arid southern desert region, and in northwestern California where the streams are probably too rapid for the use of plant poisons, piscicides are generally employed. Apparently deriving from California are the Intermontane Plateau occurrences on the Owens, Humboldt, and Owyhee Rivers. The few Columbia River groups who claim to have used piscicides probably got their knowledge from farther south, since piscicides are not noted farther north. There is no reason to postulate independent origin of the Columbia River enclave since the Oregon gap to the south is small, the country rather

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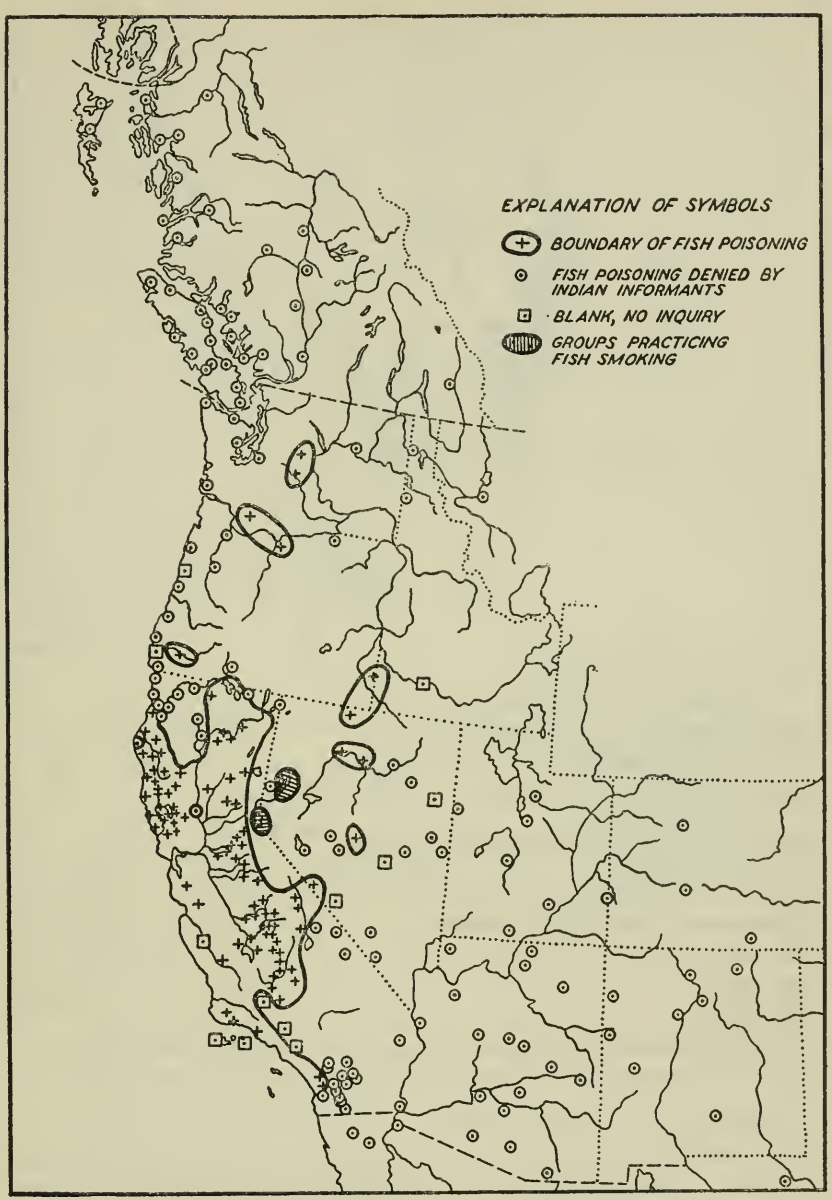
[62] This does not include the putative fish-drugging plant, *Angelica*.

[63] Map 3 may be supplemented by the list given in table 7, which is made up from the ethnographic literature published before the CED survey was instituted. A similar map, together with a valuable discussion, has recently been published by Rostlund (1948).

[64] For location of groups on my maps 3 and 4 and for the groups listed immediately hereafter, see Kroeber's (1939) key and master list. SS (Area I, Pomo), angelica, *Angelica* sp.; SL (Area G, Sinkyone), parsnip; Te (Area D, Tenino), sunflower, *Helianthella* (?) sp.; Mn (Area L, Mono), Mi (Area L, S, Miwok), pepperwood, *Umbellaria californica;* MV (Area K, Maidu), horehound, *Lycopus* sp.; SS, Ic, BW, NE (Area I, Pomo), manroot, *Echinocystis fabacea* (?), or *E. oreganus;* OB (Area M, Paiute), slim solomon, *Smilacina sessilifolia*.

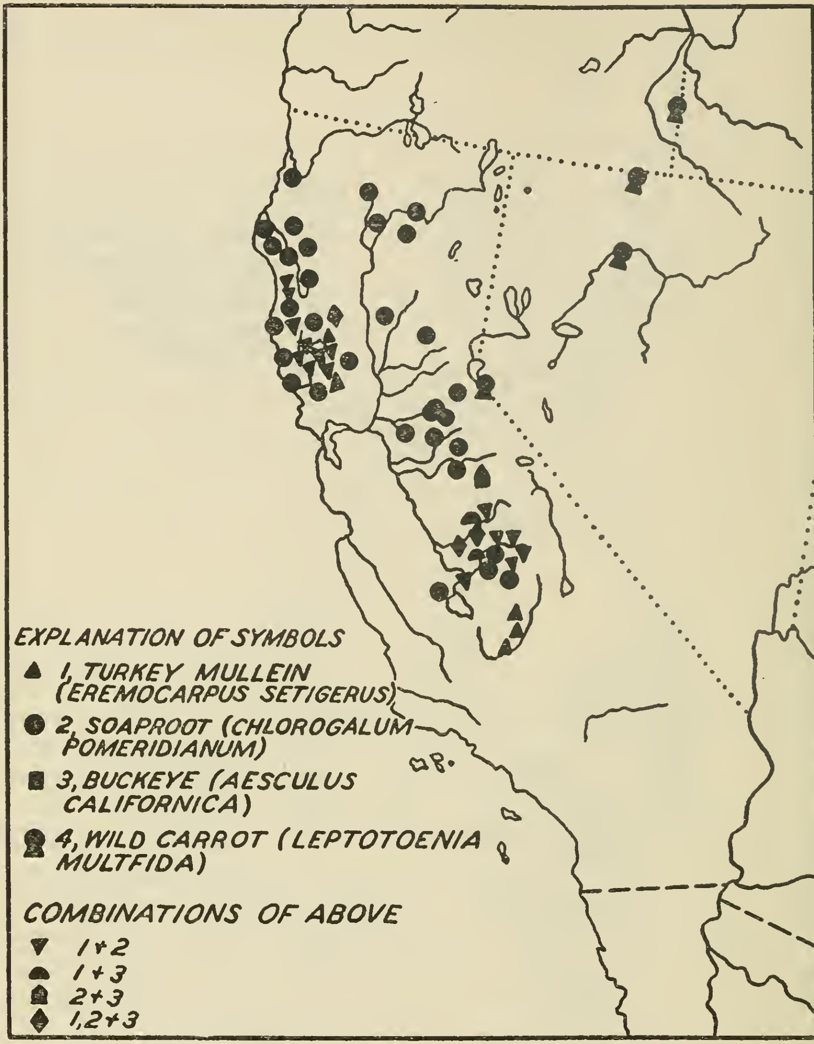
[65] Merrill (1923) shows by a series of maps that the actual botanical distribution of plants used for basketry making in California is consistently wider than their cultural employment. (See also Heizer, 1941.)



MAP 3.—Distribution of fish-poisoning in western North America.

arid and ethnographic information very scarce.[66] Piscicides in these three culture areas seem to be classifiable as a somewhat discontinuous unit.

[66] The postulated northward diffusion presumably took the route of the western interior (Willamette Valley).



MAP 4.—Distribution of fish-poison plants in western North America.

The unique Great Basin (Nevada) practice of "fish smoking" is of much interest, since it seems to be, in view of its isolation, a local invention. Unfortunately, we lack details as to what type of water body was treated, the plant which was burned, and effects on the fish.

MEXICO AND CENTRAL AMERICA

There is some indication that the western part of northern Mexico generally practiced fish drugging. Table 9 gives the occurrences and plants used. There is little to discuss, since we lack full, specific information. *Hura crepitans* L. is cultivated in Mexico as a fish-poison plant (Rose, 1899, p. 25). This is the most northerly continental cultivation of plants with piscicidal properties in the New World.

Map 2 immediately suggests a problem—are the Mexican and Californian occurrences historically related? There is a definite gap among the Colorado desert Yuman-speaking peoples.[67] The Cocopa employment of willow leaves, which, if used in quantity, produce astringent tannin, may actually be an independent invention.[68] A social factor which may have retarded the spread of the idea of fish drugging is the Southwestern prohibition against eating fish.[69] This taboo is recorded for the Yavapai, Walapai, Havasupai, Hopi, Navaho, Zuni, Western Apache, Mescalero, and Jicarilla Apache (Spier, 1928, p. 123), Wichita (Beals, 1932, p. 167), and Papago (Beals, 1934, p. 13). It is recorded for at least one Great Basin Shoshoni group (Steward, 1943). Here is a great block of people who do not even catch or eat any fish. If the California-Mexican practice of narcotizing fish with poison plants is historically connected, then it either skirted to the west of this noneating area, or it was transferred before the taboo was in operation. The probable route of spread would, in this southwestern area, be mainly along the coast, rather than through the arid interior which has few streams suitable for poisoning.

SOUTHEASTERN UNITED STATES

Fish drugging has a rather restricted distribution in the Southeast.[70] It occurs east of the Mississippi among the following ethnic groups: Yuchi, Creek, Catawba, Cherokee, Choctaw, Delaware, and Iroquois (?).[71] There is a tradition of the former presence of fish poisoning among the Pamunkey, Chickahominy, and Mattaponi.[72]

The use of *Aesculus* nuts as a fish stupefacient suggests a parallel with their relatively common use in parts of California.

Fish poisoning seems to have been unknown between the Intermontane Plateau (Great Basin) and the Mississippi River. The origin of Southeastern piscicides apparently does not lie in the interior of North America—the western Gulf coast literature has failed to yield any mention of fish drugging, and at least one Southern Caddo group (Wichita) claim the taboo against eating fish. The Mexican-South-

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[67] The Cocopa (Yuman-speaking) are an exception (Gifford, 1933, p. 268).

[68] For further discussion, see page 258 of this paper.

[69] In certain parts of the Old World the prohibition against polluting the water may have worked against the adoption of the use of fish poisoning. For a similar type of culture process, see Tschopik (1938). Matthews (1898) has made an interesting study of "ichthyophobia." The fish-eating taboo is practiced in parts of North Africa (Bates, O., 1917, pp. 210–211).

[70] Swanton, 1928, p. 694; Gower, 1927, pp. 26–27; Adair, 1930, p. 432; Flannery, 1939, p. 19.

[71] Handbook of American Indians vol. 1, p. 462, says the Iroquois practiced fish poisoning. Flannery (1939, p. 183), says it is absent among Huron-Iroquois groups.

[72] Flannery, 1939, p. 19; Speck, 1924, p. 191; 1928, pp. 364–65.

eastern gap may be a true area of absence, a region which never knew the use of piscicides. If so, we must look either for an independent origin in the Southeast, or to South America via the Antillean route.

ANTILLES

The Greater and Lesser Antillean Islands are only now becoming known from the anthropological standpoint. Loven (1935) has published the fullest single study of the area, and has paid particular attention to possible cultural affiliations with North and South America. Loven states that the Island-Caribs got poison from *conami*, a cultivated herb, and adduces from linguistic evidence that this herb came from the southern mainland and that the Antilles were, "in the matter of fish-poisoning, . . . only a cultural offshoot of South America (Loven, 1935, pp. 423–424). P. Browne [73] says, "The 'Surinam poison' (*Tephrosia toxicaria* Sw. Pers.) has been introduced to Jamaica from the main, and is now cultivated in many parts of the island . . ." Table 8 lists the occurrences of piscicides in the Antillean islands. In view of the certainty of the successive Arawak and Carib migrations into the Antilles from northeastern South America, there is every reason to believe that Loven's conclusion is correct. Since the Southeastern United States area of piscicides does not connect via the Gulf coast with Mexico,[74] it seems likely that it may be historically related to the Antillean (and ultimately South American) area of fish drugging.

SOUTH AMERICA

I might say at the outset that there is so much information on South American piscicides that it has proved beyond the scope of this paper to attempt an exhaustive synthesis. Radlkofer, Greshoff, and Ernst all have long lists of piscicides used in this area. The early explorers (particularly such men as Spix, Martius, and Schomburgk) paid particular attention to this aspect of economic utilization of plants. Nordenskiöld [75] has gone through part of the historical sources and has presented a map. Métraux (1928, map) subsequently enlarged on the work of Nordenskiöld. The best sources on this subject, and as yet nearly untouched by anthropologists, are in the botanical papers on South America.[76] These sources are listed and used by Ernst, Greshoff, Radlkofer, Roark, and Killip and Smith.

[73] Quoted by Greshoff II, p. 47.

[74] This statement is made with some reservation, since literary source material for the Gulf coast groups (Coahuilteco, Tonkawa, Karankawa, Atakapa, etc.) are few. Those which I have consulted make no mention of fish drugging.

[75] 1920, pp. 40–43, map 6 (p. 45). I believe that fish poisons would be amenable to linguistic treatment of the type done by Nordenskiöld.

[76] See Killip and Smith, 1935; Roark, 1936, 1938.

The use of piscicides seems to be an old culture element in South America. Numerous plants are cultivated, the custom is very widespread, and the number of recorded fish poisons is probably greater than that of any other continent. (See table 10.) I quote from Howes, who says:

> An interesting feature about some of these South American species is that they have not yet been recorded away from the precincts of man, and are known only from aboriginal cultivations, it being common practice among certain tribes to cultivate a few plants round their habitations to supply their wants in fishing. Altson, who has made a special study of these plants in British Guiana, lays emphasis on this fact, and points out that some species never seem to flower. Over a period of some years spent in British Guiana this observer was unable to find certain of these plants in flower or in fruit in spite of a continual lookout being kept and specimens frequently being seen. The following plants are stated to be known only from native habitations in British Guiana: *Clibadium sylvestre* (Aubl.) Baill., *Tephrosia toxicaria* (Sw.) Pers., *Euphorbia cotinoides* Miq., *Phyllanthus* sp. A distribution of this sort courts the assumption that these plants have been under cultivation throughout a considerable period. If this is so, one would expect a wide degree of variation to exist within each species, variation extending also possibly to the degree of toxicity. [Howes, 1930, p. 135.]

That certain plants depended for their existence in some places upon native cultivation is also demonstrated by Chevalier (1925, pp. 1520–1523), who showed that *Tephrosia toxicaria* Pers. must have been more widespread in pre-Contact times. At the time of Plumier's voyage (1689–97) this plant was common in the Antilles, but subsequently became more and more rare and almost disappeared with the extinction of the Caribs. The implication is that without planting and tending by the natives the plant did not propagate itself.[77]

The distribution of fish poisoning for South America shown on map 2 is more or less generalized, but it is necessarily so. For a spot-map of South America, those of Nordenskiöld and Métraux will do very well.

It is unnecessary to emphasize that map 2 exhibits a continuous distribution from South America through Central America to northern Mexico, and from South America through the Antilles to the southeastern United States. It is difficult to avoid the conclusion that we are dealing with a single, widely distributed concept which has a South American focus of origin, dispersal center, and highest, or most complex, development.[78]

[77] This is the case with the banana which is planted, not from seeds, but from "slips" or "sets." This is a specialization of long cultivation, the plant being unable to propagate itself naturally and without human interference. It is, in biological terms, a symbiotic relationship brought about through cultivation by man over a long period of time. A situation of this sort implies some antiquity for the use of piscicides. (Cf. Howes, 1930, p. 135; Cook, 1925.)

[78] Métraux (1928, p. 93) says, "Fishing with the aid of poison is not practiced by the Tupí-Guaraní of the Upper Xingu, which seems to indicate that this procedure has been discovered at a recent date, probably in the Amazon basin." This conclusion seems questionable, since cultivation of piscicidal plants and the wide distribution of the practice indicate fish poisoning is an old South American cultural feature. A more likely explanation is either that these Tupí-Guaraní did not choose to practice fish stupefying, or that certain environmental features militated against the practice.

SUMMARY

THE OLD WORLD

In the particular sections of analyses of distribution it is intimated that the Euro-Asian occurrence of fish drugging, notwithstanding the apparent Turko-Iranian discontinuity, is probably a historical unit. Australian fish poisoning may have been diffused first to Queensland from Melanesia. Oceanian fish stupefying was probably borrowed from an ultimate continental Asiatic source through the intermediate Indonesian route. Africa seems either to have developed piscicides independently, or to have shared, at an earlier time, the concept with the north (Europe), or to have borrowed it from the east. External influence has profoundly affected much of African culture, and fish drugging may possibly be a custom originally learned from peoples outside that continent, subsequently became enlarged and elaborated, and later was diffused widely within the continent.

It remains now to attempt to explain the large areas in the Old World in which fish drugging is lacking. If it is admitted that fish drugging in the Old World had a unitary origin and subsequent diffusion which is approximated on map 2, then the reason for absence is simply that the concept did not spread there. But there are factors (environmental, cultural, or both) which condition diffusion and it is possible to give reasons to account for certain blank spots on the distribution map.

In a recent paper, Findeisen,[79] states that there is no record of fish poisoning among the Siberian tribes. This categorical dismissal of the presence or absence is open to question, for there are certain references, however inexact, to piscicides in Siberia. Radlkofer (1887, p. 409) notes that in Siberia *Rhododendron dauricum* L. is used as a piscicide. Northern Asia is mentioned as the location of the piscicidal use of *Daphne mezereum* L., but since Europe is also mentioned, this Asiatic occurrence may be in northwestern Russia (Radlkofer, 1887, p. 412). *Verbascum phlomoides* L. and *V. thapsiforme* are noted as piscicides "in verschiedenen Teilen des Russischen Reiches" and "in het gouvernement Moskou" (Greshoff III, p. 144). The implication here is that extreme western Russia is meant—the possibility of European influence is a logical explanation for the presence of fish poisoning here. A likely factor militating against the use of piscicides in the far north is proposed by von Middendorf, who says:

> Ein grosser Vorzung den der Norden besitzt, is der, dass keine Giftpflanzen zu ihm hinanreichen. Mir is nur ein einziges Beispiel einer für giftig erkannten hoch Nordischen Pflanze bekannt, indem Hed. Mackenzii (*Hedysarum mackenzii*

[79] Findeisen, 1929, p. 18. The area and tribes considered by this author will be found on p. 4.

Richards.) brechenerregend erklärt wird und in einem Fall fast tödtliche Zulfalle hervorrief. [Von Middendorf, 1867, vol. 4, p. 697.]

This is a statement of real significance, for it offers a possible explanation for the absence of fish poisoning in Asia north of 40° latitude.[80] Without proper plants with which to stupefy fish, people could neither invent fish poisoning, nor accept the concept if they had the opportunity to learn of it from others who practiced the use of piscicides. It will occur to the reader that fishing in general is of tremendous importance to the northern peoples in Asia.[81] But a whole series of mechanical techniques are here applied to securing fish—weirs, nets, hook-and-line, harpoons, and spears. These are methods which take the place of fishing with poison.

There is no reason to believe that the fish-drugging technique has ever been present in the blank area of northeastern Asia shown on map 2. Thus, the question of Old World introduction into North America cannot be raised. Where the place of origin of the practice of fish poisoning in the Old World was, or when the origination took place there is no way of telling.

THE NEW WORLD

The main point which I have attempted to bring out in the analysis of the distribution of fish drugging in the New World is that, with minor and generally explainable exceptions, the distribution is continuous.

Since the area within which this practice is carried on in the New World is a large, single, and connected one, I see no reason to doubt a unitary origin and a dispersal from some focus. When this diffusion took place there is no way of telling. It is clear, however, that the wide geographical extension and the numerous local specializations of the use of piscicides indicate a cultural element of some antiquity.[82] The fons et origo of New World piscicides could hardly have been in the Old World—the gap is too broad between the recent Asiatic and American occurrences. Everything points to tropical South America with its many well-stocked fishing streams and superabundance of wild plants with piscicidal potentialities as the fountainhead. The general area in South America in which I believe the use of piscicides may have originated is indicated on map 2.

Assuming a northern South American origin, we can visualize the use of fish poisons slowly spreading to the south and north. Southern South America (at about 37° S. latitude) seems to be the southern

[80] For further data on seasonal, locational, and climatic conditions affecting the toxicity of plants, see Pammel (1911, pp. 83-85), Howes (1933), Cornevin (1887, p. 214).

[81] For a good discussion of this, see Birket-Smith (1929), Findeisen (1929).

[82] Beals (1932, p. 104), on the basis of few cited data, proposes fish stupefying as an "old American substratum trait."

limit, with the exception of the Chilean occurrence which probably spread down the coast. Piscicides probably traveled northward through the Lesser Antilles, the Greater Antilles, and into the southeastern United States, but did not diffuse east of the Mississippi River or north of the Ohio except along the coastal strip occupied by the southeastern Algonkians. Fish drugging may or may not have reached the Iroquois of New York State.

A northwestward diffusion from South America introduced the practice of fish drugging in Middle America. The intensive agriculturists seemed to have had little regard for its use, and it again becomes an important subsistence method north of the Valley of Mexico in the western slopes of the highland and the west coast. The impulse was barely recorded in Baja California. The important question of the possible southern derivation of Californian fish poisoning is hard to decide. Between the Colorado River and southern California coast is a desert area in which, in all probability, fish poisoning has never been practiced. But aboriginal cultural contacts and diffusion across the southern California desert are known, and it seems not unlikely that through such contacts the knowledge and use of fish-poison plants may have been spread. Perhaps the introduction was via the coast northward from Baja California to littoral southern California and from thence to the Interior Valley and into the Great Basin.[83] Whatever the actual case, I am reluctant to point out California as a truly isolated area of autochthonous origin and development of piscicides, particularly since the discontinuity of distribution is actually quite small. After all, fish drugging apparently was distributed through the arid Great Basin area and sporadically through the more or less uncongenial region of central Oregon as far north as the Columbia River.

Fish poisoning seems to have a sharply defined northern limit in North America—I can find no evidence of piscicides on the northwest coast,[84] Mackenzie Basin,[85] or Alaskan areas. This seems to be an area which does not, and presumably never did, use piscicides.

In this light, fish poisoning clearly seems to have originated within the New World independently of any other developments in the rest of the World.[86]

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[83] There is, however, no record of Cochimi, Kiliwa, or Akwa'ala fish drugging in whose territories there are no suitable watercourses.

[84] The University of California Culture Element Distribution Studies attest solid negatives for fish poisons in the northwest coast area.

[85] The late Dr. J. M. Cooper told me that none of the northern Algonkians know fish poisoning.

[86] Vellard (1941, pp. 94, 106) says of South America fish poisoning, "C'est un nouveau point de contact a signaler entre les regions indo-malaises at americaines." There seems to me no warrant for proposing a transoceanic diffusion of fish drugging to the New World. Trans-Pacific diffusionists may find a basis for argument in the South American name of *Lobelia tupa* L. of "tupa" in Peru and Chile, which is close to the general Malaysian word of "tuba," referring to fish-poison plants (Greshoff I, p. 94). A single instance of this sort can, however, be only of limited significance.

NOTES ON THE TABLES

In the following tables will be found listed, according to geographical area, plants used as piscicides. These lists are not complete, and give only a sampling of the plants used and places where piscicides are employed. Although drawn largely from the lists given by Ernst, Radlkofer, Greshoff, and Howes, my lists contain supplementary material which has been culled from ethnographic accounts.

Each entry is accompanied by a bibliographic citation, often to a secondary source which in turn will give reference to the original or primary source.

In a general study of this sort, mention should be made of the sources from which the working data have been drawn. No anthropologist seems to have ever attempted the truly formidable task of collecting *all* data on piscicides from primary source materials. Such sources are extremely varied—botanists' reports, plant lists, explorers' journals, and ethnographic accounts. There are, however, a number of treatments by botanists of fish-poison plants. Ernst (1881), Radlkofer (1887), Greshoff (I, 1893; II, 1900; III, 1913), Hamlyn-Harris and Smith (1916), and Howes (1930) have been the main contributors in this respect. These papers all have the status of secondary sources, since they are syntheses or abstracts of primary references. My justification for placing chief reliance on these secondary sources is that the original papers are in large part difficult or impossible to consult: references are often in the form of verbatim quotations, and are always accompanied by source citation. Such secondary authorities are of a very high grade.

For the convenience of those who have the occasion to consult the main sources utilized for this study, there is presented on pages 232 and 233 the references in these works to (1) botanical lists, (2) source lists of genera containing certain plant toxins, (3) the bibliographies in the works of these authors dealing with fish-poison plants, and (4) folk names of fish-poison plants.

Table 1.—*Distribution of fish-poison plants in southern Asia and Indonesia*[1]

Area	Plant	Part used	References
Armenia	*Rhododendron caucasicum* Pall		Greshoff I: 95–96.
Persia[2]	*Anamirta* sp		Greshoff II: 120.
	Anamirta paniculata Colebr	Berries	Greshoff II: 13.
Arabia[2]	*Tephrosia tomentosa* Pers		Radlkofer, 1887: 405.
	Balanites roxburghii Planch	Bark	Greshoff I: 29.
	Anamirta paniculata Colebr	Berries	Greshoff II: 13–15.
Iraq	*Anamirta paniculata* Colebr		Greshoff II: 14.
Yemen	*Anamirta paniculata* Colebr	Fruit	Do.
Palestine	*Anamirta paniculata* Colebr	do	O. Mason, 1895: 299.
	Cyclamen latifolium Sibth. and Sm.	Root	Hornell, 1941: 126–127.
	Styrax officinalis L	Seeds	Do.
	Verbascum sinuatum L	Plant	Do.
North India	*Zanthoxylum alatum* Roxb	Bark, fruit	Greshoff II: 29–30.

[1] For full data on Malaysia, see Hickey, 1950, and Rumphius, 1750-1755.
[2] Introduced from the West Indies.

TABLE 1.—*Distribution of fish-poison plants in southern Asia and Indonesia*—Continued

Area	Plant	Part used	References
East India	*Hydnocarpus laurifolia* (Dennst.) Sleumer.	Fruit	Radlkofer, 1887: 402.
	Derris uliginosa (Roxb.) Benth	Roots	Radlkofer, 1887: 407.
	Nicotiana tabacum L		Radlkofer, 1887: 411.
Central India	*Terminalia bellerica* Roxb	Bark	Greshoff II: 75.
	Strychnos nux-vomica L	Seeds	Greshoff I: 106.
West India	*Tetracera assa* DC	Bark	Radlkofer, 1887: 401.
	Anamirta cocculus Wight and Arn.	Fruit	Do.
	Walsura piscidia Roxb	Bark, fruit	Radlkofer, 1887: 402; Raizada and Varma, 1937: 206
	Bignonia capreolata L		Radlkofer, 1887: 412.
Punjab	*Euphorbia royleana* Boiss	Juice	Khan, 1930: 193.
India	*Tinospora cordifolia* Miers	Bark	Raizada and Varma, 1937: 204.
	Schima wallachii Chois	do	Raizada and Varma, 1937: 205.
	Balanites roxburghii Planch	do	Do.
	Sapindus trifoliatus L	Fruit, root	Raizada and Varma, 1937: 206.
	Acacia pennata Willd	Fruit, stem	Do.
	Albizzia procera Benth	Bark	Do.
	Caesalpina nuga Ait	Fruit, stem	Raizada and Varma, 1937: 207.
	Dalbergia stipulacea Roxb	Bark, root	Do.
	Derris elliptica Benth	Root	Do.
	Entada scandens Benth	Seed	Do.
	Millettia pachycarpa Benth	Root	Raizada and Varma, 1937: 208.
	Mimosa himalayana Gamble	Bark	Do.
	Ougeinia dalbergioides Benth	do	Do.
	Pithecolobium bigeminium Benth	Leaves, bark, seed.	Do.
	Pongamia glabra Vent	Seed, root	Raizada and Varma, 1937: 209.
	Tephrosia candida DC	Roots, leaves	Do.
	Cacsaria graveolens Dalz	Fruit	Raizada and Varma, 1937: 210.
	Artemesia vulgaris L	Leaves, bark	Do.
	Eupatorium odoratum L.[2]	Plant	Do.
	Rhododendron falconeri Hook. f	Flower beds	Do.
	Anagallis arvensis L		Raizada and Varma, 1937: 211.
	Cyclamen persicum Miller	Root	Do.
	Maesia indica Wall	Leaves, bark	Do.
	Bassia latifolia Roxb [2]	Seeds	Do.
	Diospyros montana Roxb	Fruit	Do.
	Melodinus monogynus Roxb	Bark	Raizada and Varma, 1937: 212.
	Nerium odorum Solander	Bark, root	Do.
	Asclepias curassavica L.[2]	Plant	Do.
	Verbascum thapsus L	Seeds	Do.
	Dolichandrone falcata Seem	Bark	Do.
	Eremostachys vicaryi Benth	Plant	Raizada and Varma, 1937: 213.
	Lasiosiphon ericephalus Dcne	Leaves, bark, root.	Do.
	Linostoma decandrum Wall	Fruit, stem	Do.
	Croton tiglium L	Fruit	Do.
	Euphorbia tirucalli L	Juice	Do.
	Flueggia leucopyrus Willd	Bark, leaves	Raizada and Varma, 1937: 214.
	Sapium indicum Willd	Seeds	Do.
	Antiaris toxicaria Lesch	Juice	Do.
	Cannabis sativa L	Stem, leaves, flowers.	Do.
	Juglans regia L	Unripe fruit rind.	Raizada and Varma, 1937: 215.
	Myrica nagi Thunb	Bark	Do.
	Gnetum scandens Roxb	Leaves	Do.
	Taxus baccata L	Leaves, branches	Do.
	Corypha umbraculifera L	Fruit	Do.
	Anamirta paniculata Colebr	Berries	Greshoff II:13.
	Randia dumetorum Lam	Fruit	Howes, 1930:141; Raizada and Varma, 1937: 210.
	Gynocardia odorata R. Br	Fruit, leaves, bark.	Raizada and Varma, 1937: 204.
	Barringtonia acutangula (L.) Gaertn.	Fruit, bark, root.	Raizada and Varma, 1937: 209.

TABLE 1.—*Distribution of fish-poison plants in southern Asia and Indonesia*—Continued

Area	Plant	Part used	References
India	*Cleistanthus collinus* (Roxb.) Benth. and Hook.	Bark	Howes, 1930:141; Hooper, 1898.
	Fluggea leucopyrus Willd	do	Greshoff III:87.
	Zanthoxylon alatum Roxb	Seeds, bark	Khan, 1930:193; Raizada and Varma; 1937:205.
	Casearia tomentosa Roxb	Seeds	Khan, 1930:193.
South and West India	*Mundulea suberosa* (DC.) Benth	Bark, seeds	Howes, 1930:133; Greshoff I:56–57.
Ceylon	*Hydnocarpus venenata* Gaertn		Greshoff II:21; I:19–20.
	Pachygone ovata Miers		Radlkofer, 1887:402.
	Dioscorea bulbifera L	Root	Greshoff III:28.
	Derris scandens Benth	Plant	Greshoff III:74.
	Derris benthamii Thwaites	Root	Stockdale, 1928:78–79.
Travancore	*Diospyros montana* Roxb	Fruit	Howes, 1930:141.
Hindustan	*Crinum asiaticum* L	Leaves, roots	Greshoff II:151.
Sikkim	*Gynocardia odorata* (Roxb.) R. Br	Fruit	Greshoff I:19; II:21.
	Bassia butyracea Roxb	Bark	Greshoff II:101.
Nepal	*Zanthoxylum alatum* Roxb	Seeds	Greshoff I:28.
Assam	*Myrica nagi* Thunb	Bark	Greshoff II:146.
	Millettia piscidia (Roxb.) Wight and Arn.	Bark, flowers	Greshoff, I:54.
Burma	*Hydnocarpus castanea* Hook f. and Th.	Fruit	Greshoff II:21–22.
	Tephrosia candida DC	Leaves	Greshoff II:48; Howes, 1930:140.
	Acacia pruinescens Kurz	Bark	Greshoff II:69; F. Mason, 1883: vol. 2, p. 543.
	Spilanthes paniculata DC		F. Mason, 1883: vol. 2, p. 380.
Perak, Selangor	*Derris ellipitica* (Roxb.) Benth	Root	Skeat and Blagden, 1906: vol. 1, pp. 211, 213; Harris. 1925.
Bengal	*Tephrosia candida* DC	Leaves	Greshoff II:48.
Cochin China	*Anamirta paniculata* Colebr	Berries	Greshoff II:13.
Malakka	*Hydnocarpus castanea* Hook f. and Th.	Fruit	Greshoff II:21–22.
Andaman Islands	*Hydnocarpus castanea* Hook f. and Th.	do	Greshoff II:21–22.
	Lagerstroemia sp	Seeds	Man, 1883:366.
Nicobar Islands	*Barringtonia asiatica* (L.) Kurz	do	Kloss, 1903:246.
Malaya	*Diospyros toposioides* King and Gamble.	Fruit	Howes, 1930:141.
	Derris elliptica (Roxb.) Benth	Roots	Evans, 1937:219; Martin, 1905:792; G. Maxwell, 1907: 246–64; Ishikawa, 1916; Wray, 1892.
Java	*Millettia dasyphylla* (Miq.) Boerl		Greshoff III:69.
	Pittosporum javanicum Bl	Fruit	Greshoff II:22.
	Hydnocarpus heterophylla Bl		Radlkofer, 1887:402.
	Millettia sericea Wight and Arn	Stalk, leaves	Radlkofer, 1887:406.
	Derris uliginosa (Roxb.) Benth	Root	Radlkofer, 1887:407.
	Cocculus indicus		Raffles, 1830:208–209.
	Albizzia stipulata Boiv	Bark	Radlkofer, 1887:408.
Sumatra	*Millettia sericea* Wight and Arn	Roots	Greshoff II:49–51.
	Polygonum erythrodes Miq	Sap	Greshoff III:35.
	Symplocos racemosa Roxb	Bark	Greshoff III:129.
	Derris sp	Roots	Marsden, 1811:186.
Timor, Alor	*Barringtonia racemosa* (L.) Bl		Greshoff II:176.
	Derris elliptica (Roxb.) Benth		Greshoff II:174–75.
Celebes	*Callicarpa longifolia* Lam	Leaves	Greshoff II:180–81.
	Barringtonia asiatica (L.) Kurz	Fruit	Greshoff II:176.
	Millettia sericea Wight and Arn	Roots	Greshoff II:173.
	Anamirta paniculata Colebr	Fruit	Greshoff II:169.
	Croton tiglium L	do	Howes, 1930:141.
Borneo		Roots	Hose and McDougall, 1912: 139–140.
	Derris elliptica (Roxb.) Benth	do	H. L. Roth, 1896:458–460; Furness, 1902:185–89; Mjoberg, 1930:100–102; Nieuwenhuis, 1904:192–196.
Moluccas	*Euphorbia neriifolia* L		Radlkofer, 1887:413.
	Abrus pulchellus Wall		Radlkofer, 1887:406.
	Aegiceras minus Gaertn	Bark	Radlkofer, 1887:409.
Ceram	*Phyllanthus distichus* Muell	Roots	Greshoff II:182.
Philippines	*Croton tiglium* L	Fruit	Howes, 1930:141.
	Diospyros sp	do	Do.
	Harpullia arborea (Blanco) Radlk		Radlkofer, 1887:405.
	Diospyros ebenaster Retz	Fruit	Radlkofer, 1887:410.
	Maesa denticulata Mez		Greshoff III:125.

TABLE 1.—*Distribution of fish-poison plants in southern Asia and Indonesia*—Continued

Area	Plant	Part used	References
Philippines	*Entada phaseoloides* (L). Merr	Stalk	Greshoff III:62.
	Derris elliptica (Roxb.) Benth	Roots	W. H. Brown, 1921:79.
	Derris philippinensis Merr	do	Do.
	Derris trifoliata Lour	do	Kalaw and Sacay, 1925.
	Galactia sp	Bark	Blair and Robertson, 1903–09: vol. 43, p. 273.
	Anamirta cocculus Wight and Arn.	Fruit	Do.
	Euphorbia pilulifera L	Plant	Blair and Robertson, 1903–09, vol. 48, p. 122.
	Albizzia saponaria (Lour.) Bl	Bark	Greshoff III:61.
	Albizzia acle (Blanco) Merr		Do.
	Pachygone ovata Miers	Fruit	Greshoff II:16.
	Derris polyantha Perk		Greshoff III:74.
	Derris elliptica (Roxb.) Benth		Greshoff III:78.
	Ganophyllum falcatum Bl	Bark	Greshoff III:83.
	Barringtonia balabacensis Merr		Greshoff III:117.
	Datura metel L	Plant	Greshoff III:139–140.
	Gliricidia sepium (Jacq.) Steud		Greshoff I:67, 70; II, 51.
Singapore	*Derris elliptica* (Roxb.) Benth		Radlkofer, 1887:407.
Cochin China	*Crinum asiaticum* L	Leaves, roots	Greshoff II:151.
Coromandel	*Grewia asiatica* L		Radlkofer, 1887:402.
Kei Islands	*Millettia sericea* Wight and Arn	Plant	Greshoff I:57.

TABLE 2.—*Distribution of fish-poison plants in Oceania* [1]

Area	Plant	Part used	Reference
Marianas Islands	*Barringtonia asiatica* (L.) Kurz	Juice	Howes, 1930: 143.
Caroline Islands	*Derris elliptica* (Roxb.) Benth		Greshoff II: 62.
New Britain	*Barringtonia asiatica* (L.) Kurz		Howes, 1930: 143–144.
Mentawai Islands	*Derris elliptica* (Roxb.) Benth		Pleyte, 1901: 7.
Bismarck Archipelago.	*Barringtonia asiatica* (L.) Kurz		Howes, 1930: 143–144.
Torres Straits (Mabuiag).	*Derris uliginosa* Benth	Roots	Hamlyn-Harris and Smith, 1916: 11.
	Tephrosia purpurea Pers	Plant	
New Caledonia	*Orobus piscidia* Spr. (?)		Radlkofer, 1887: 406.
	Calophyllum montanum Vieill		Greshoff II: 24.
Solomon Islands	*Barringtonia* sp	Fruit	Kloss, 1903: 246.
New Guinea	*Harpullia thanatophora* Bl	Bark	Radlkofer, 1887: 404.
	Derris elliptica (Roxb.) Benth	Roots	Van der Sande, 1907: 170.
Samoa	*Barringtonia asiatica* (L.) Kurz	Fruit, bark	Buck, 1930: 443–444; Setchell, 1924: 214.
	Phyllanthus simplex Retz		Greshoff III: 88.
	Ipomoea sp. (?)		Churchill, n. d.: 122.
	Tephrosia purpurea (L.) Pers	Root, plant	Buck, 1930: 443–444.
Society Islands	*Lepidium bidentatum* Montin		Greshoff II: 18.
	Tephrosia purpurea (L.) Pers	Plant	Ellis, 1853: 140.
	Wikstroemia foetida (L. f.) A. Gray.		Stokes, 1921: 231.
New Zealand	*Lepidium oleraceum* Forst. (?)		Radlkofer, 1887: 402.
Hawaii	*Piper methysticum* Forst	Plant	Greshoff II: 132.
	Cocculus ferrandianus Gaud	Seeds	Greshoff II: 16. Bryan, 1915: 341–342.
	Tephrosia purpurea (L.) Pers	Plant	Stokes, 1921: 226.
	Wikstroemia spp	do	Do.
	Lagenaria siceraria (Mol.) Standl	Fruit	Do.
	Colubrina asiatica Brongn		Rock, 1913: 283.
Viti Islands (Fiji)	*Derris trifoliata* Lour	Stem, leaves	Greshoff I: 71: II: 61; Hornell, 1941: 127.
	Barringtonia asiatica (L.) Kurz		Greshoff I: 71: II: 62; Seemann, 1862:339.
Marquesas Islands	*Derris malaccensis* Prain	Root (?)	Hornell, 1941: 127–128.
	Tephrosia purpurea (L.) Pers		Do.
	Pittosporum sp		Do.
	Derris trifoliata Lour	Stem, leaves	Seemann, 1862: 339.
	Barringtonia asiatica (L.) Kurz	Fruit	Handy, 1923: 178.
Rarotonga	*Barringtonia asiatica* (L.) Kurz	Kernel	Buck, 1928.
Tahiti	*Barringtonia asiatica* (L.) Kurz	Nuts	Ellis, 1859: 140; H. St. John, information.
Guam	*Barringtonia asiatica* (L.) Kurz	Fruit	Safford, 1917 b: 81–82.
Loyalty Islands	*Cerbera manghas* L	Fruit (?)	Sarasin, 1929: 83.
	Euphorbia sp	Sap	Do.
	Barringtonia asiatica (L.) Kurz	Fruit (?)	Do.
	Desmodium sp		Do.

[1] For general data see Stokes, 1921; Buck, 1928; C. F. Maxwell, 1912.

TABLE 3.—*Distribution of fish-poison plants in Europe and northern Asia*

Area	Plant	Part used	Reference
Northern Europe	*Digitalis thapsi* L.		Radlkofer, 1887:412.
	Verbascum nigrum L.	Seeds	Greshoff I:110.
Europe	*Agrostemma githago* L.	do	Greshoff III:39.
	Euphorbia esula L.		Howes, 1930:148:Radlkofer, 1887:413.
	Euphorbia platyphylla L.		Radlkofer, 1887:413.
	Taxus baccata L.		Radlkofer, 1887:415.
	Cyclamen europaeum L.		Radlkofer, 1887:409.
	Cyclamen graecum Link		Do.
	Verbascum thapsus L.		Radlkofer, 1887:411.
	Verbascum phlomoides L.	Plant	Do.
	Anamirta cocculus Wight and Arn.	do	Krause, 1904:131.
England	*Euphorbia hiberna* L.	Leaves	Greshoff I:127.
	Euphorbia coralloides L.		Greshoff II:136.
Ireland	*Euphorbia hiberna* L.	Leaves	Greshoff I:127; Aristotle, 1883 (1910 ed.): 602.
Southern Ireland	*Euphorbia coralloides* L.		Greshoff II:136.
France (Bretagne)	*Anamirta cocculus* (L.) Wight and Arn.	Berries	Anonymous, 1884:186.
	Anamirta paniculata Colebr.	Plant	Greshoff II:14.
Germany	*Verbascum thapsoides* Willd.	Seeds	Radlkofer, 1887:411.
	Aconitum sp.		Greshoff II:122.
	Schrophularia sp.		Do.
Southern Europe	*Euphorbia lathyris* L.		Radlkofer, 1887:413.
	Euphorbia amygdaloides L.		Howes, 1930:148; Radlkofer, 1887:413.
	Cicer arietinum L.	Plant	Greshoff III:77.
Italy	*Verbascum thapsus* L.		Howes, 1930:147.
Sicily	*Cyclamen europaeum* L.	Tubercles	Greshoff II:126.
Sardinia	*Daphne gnidium* L.	Roots	Howes, 1930:147; Greshoff III:115.
	Oenanthe crocata L.	do	Howes, 1930:148; Greshoff III:122.
Portugal	*Verbascum crassifolium* Lam. and DC.		Howes, 1930:147; Greshoff II:119.
	Daphne sp.		Howes, 1930:147.
	Anamirta paniculata Colebr.		Do.
	Oenanthe crocata L.	Root	Howes, 1930:148.
Spain	*Daphne cneorum* L.	Leaves, fruit	Radlkofer, 1887:413.
	Hyoscyamus niger L.		Radlkofer, 1887:411.
	Euphorbia hiberna L.	Plant	Radlkofer, 1887:413.
	Daphne gnidium L.		Do.
	Veratrum album L.		Radlkofer, 1887:415.
	Verbascum sp.	Plant	Howes, 1930:147.
Constantinople	*Verbascum sinatum* L.		Howes, 1930:148.
Greece	*Verbascum phlomoides* L.	Seeds	Greshoff I:109; Howes, 1930:146.
	Verbascum sinuatum L.	do	Howes, 1930;146.
	Anchusa (*italica* Retz) = *azurea* Mill.		Greshoff III:135.
	Euphorbia dendroides L.	Bark, leaves	Howes, 1930:148: Greshoff III:95.
	Euphorbia characias L.		Howes, 1930:148.
	Euphorbia sibthorpii Boiss.	Bark, leaves	Radlkofer, 1887:414.
Caucasus	*Rhododendron caucasicum* Pall.		Greshoff I:95-96.
Sibera	*Rhododendron dauricum* L.		Radlkofer, 1887:409.
Russian Empire (Moscow).	*Verbascum phlomoides* L.		Greshoff III:144.
	Verbascum thapsiforme Schrad.		Do.
Russia	*Taxus baccata* L.	Leaves	Greshoff III:12.
Northern Asia	*Daphne mezereum* L.		Radlkofer, 1887:412.

TABLE 4.—*Distribution of fish-poison plants in eastern Asia*

Area	Plant	Part used	Reference
Northern China	*Wikstroemia chamaedaphne* Meissn.		Greshoff II:134.
Southern China	*Euphorbia pulcherrima* Willd.		Greshoff II:138.
China [1]	*Melia azedarach* L.		Greshoff II:118, 138.
	Datura fastuosa L. var. *alba* (Nees) C. B. Clarke.		Greshoff II:118.
	Canarium sp.	Fruit	Greshoff II:31.
	Camellia sp.		Greshoff I:24.
Japan	*Buddleia curviflora* Hook. and Arn.	Leaves	Greshoff III:130.
	Dioscorea tokoro Makino	Roots	Greshoff III:28.
	Zanthoxylum piperitum DC.	Leaves	Greshoff III:82; I:26.
Formosa	*Milletia taiwaniana* Hayata	Roots	Kariyone et al., 1923.

[1] For further data see Greshoff II, p. 134, footnote 1.

TABLE 5.—*Distribution of fish-poison plants in Africa*

Area	Plant	Part used	Reference
South Africa	*Tephrosia macropoda* Harv	Roots	Howes, 1930: 133.
Natal	*Millettia caffra* Meissn		Radlkofer, 1887: 406.
Northeastern Transvaal.	*Adenium multiforum* Kl		Howes, 1930: 134.
Mozambique	*Tephrosia ichthyoneca* Bertol		Radlkofer, 1887: 406.
	Tephrosia vogelii Hook. f		Radlkofer, 1887: 405.
Zambezi River	*Derris uliginosa* (Roxb.) Benth	Stems	Greshoff I: 71.
Zanzibar	*Cynanchum sarcostemmatoides* K. Sch.		Greshoff III: 133.
	Euphorbia tirucalli L	Sap	Ingrams, 1931: 300; Greshoff III: 96.
Angola	*Tephrosia vogelii* Hook f	Leaves	Greshoff II: 49; Hambly, 1934: 145.
Cameroons, French Equatorial Africa.	*Tetrapleura thonningii* Benth	Seeds	Tessmann, 1913: 111–112.
	Ophiocaulon cissampeloides Mast	Leaves, stem	Do.
	Adenia lobata Engl	do	Do.
	Justicia extensa T. Anders	Leaves	Do.
	Piptadenia africana Hook. f	Bark	Do.
	Rinorea dentata (Beauv.) Kuntze	do	Do.
	Pachyclasma tessmanii Harms		Do.
Belgian Congo	*Tephrosia toxifera*	Plant	Weeks, 1913: 242–243.
	Euphorbia sp		
French Congo	*Tephrosia vogelii* Hook. f	Leaves	Avelot and Gritty, 1913: 6.
	Tetrapleura thonningii Benth	Seeds	Do.
Nigeria	*Ophiocaulon cissampeloides* Mast	Stem	Howes, 1930: 133.
	Adenium honghel A. DC	Root	Howes, 1930: 134.
	Tephrosia vogelii Hook. f		Greshoff I: 52–53.
	Mundulea suberosa (DC.) Benth	Bark, seed	Howes, 1930: 133.
Guinea	*Tephrosia vogelii* Hook. f		Radlkofer, 1887: 405.
Liberia	*Leucaena odoratissima* Hassk		Radlkofer, 1887: 408.
Gold Coast	*Elaeophorbia drupifera* Stapf	Leaves, fruit	Howes, 1930: 134.
Ivory Coast	*Strychnos aculeata* Solered	Fruit	Greshoff III: 130.
West Africa	*Erythrophleum guineense* G. Don	Bark	Howes, 1930: 133.
	Cassia sieberiana DC	Ponds	Do.
	Chailletia toxicaria G. Don		Radlkofer, 1887: 403.
Central Africa	*Cassia* sp		Greshoff II: 67.
	Balanites aegyptiaca Del		Greshoff III: 83.
	Cissus quadrangularis L		Greshoff III: 107.
Sudan	*Mundulea suberosa* (DC.) Benth	Bark, seed	Howes, 1930: 133.
	Adenium honghel A. DC	Root (?)	Howes, 1930: 134.
	Adenium speciosum Fenzl		Do.
Abyssinia	*Millettia ferruginea* Baker		Radlkofer, 1887: 406.
	Verbascum phlomoides L	Root	Greshoff I: 110.
	Lonchocarpus sp		Greshoff III: 76.
	Solanum marginatum L. f	Stalk	Greshoff III: 142.
Tropical East Africa	*Tephrosia periculosa* Baker		Howes, 1930: 133.
Madagascar [1]	*Mundulea pauciflora* Baker	Juice	Grandidier, 1928: 253; Greshoff III: 70.
	Tephrosia vogelii Hook. f	Leaves	Grandidier, 1928: 253.
	Euphorbia laro Drake	Juice	Grandidier, 1928: 253; Greshoff III: 96.
	Barringtonia asiatica (L.) Kurz	Fruit	Grandidier, 1928: 253.
	Barringtonia racemosa (L.) Bl	do	Do.
	Tephrosia monantha Baker		Chevalier, 1925: 1521.
	Mundulea striata Dubard and Dop		Greshoff III: 70.
Cape Verde Islands	*Frankenia ericifolia* C. Sm	Plant	Howes, 1930: 134; Greshoff II: 23.
	Statice pectinata Ait	do	Howes, 1930: 134.
	Aizoon canariense L	do	Do.
Madeira	*Euphorbia piscatoria* Ait		Do.
	Euphorbia mellifera Ait		Do.
Canary Islands	*Euphorbia piscatoria* Ait		Radlkofer, 1887: 413.
Mauritius, Reunion	*Taeburnaemontana mauritiana* Poir.	Bark	Greshoff II: 106.

[1] See also Linton, 1933, pp. 58–59.

TABLE 6.—*Distribution of fish-poison plants in Australia* [1]

Area	Plant	Part used	Reference
Australia	*Acacia falcata* Willd	Leaves	Howes, 1930:142.
	Acacia penninervis Sieber	do	Do.
	Acacia salicina Lindl	do	Do.
	Tephrosia purpurea (L.) Pers		Howes, 1930:144.
	Diospyros hebecarpa A. Cunn	Fruit	Howes, 1930:145; Hamlyn-Harris and Smith, 1916:17.
	Derris trifoliata Lour		Howes, 1930:145.
	Aegiceras majus Gaertn		Radlkofer, 1887:409.
	Adenanthera abrosperma F. Muell.	Bark	Greshoff III:62.
	Pongamia glabra Vent	Stems, roots	Greshoff III:77; Hamlyn-Harris and Smith, 1916:13.
Queensland	*Eucalyptus microtheca* F. Muell	Leaves	Howes, 1930:143; Hamlyn-Harris and Smith, 1916:15.
	Barringtonia calyptrata R. Br	Bark	Howes, 1930:143.
	Barringtonia asiatica (L.) Kurz	Bark, fruit	Howes, 1930:143; Hamlyn-Harris and Smith, 1916:15–16.
	Stephania hernandiaefolia Walp	Plant	Shirley, 1896.
	Garcinia cherryi Baill	do	Walter E. Roth, 1901:19.
	Thespesia populnea Corr	Fruit	Hamlyn-Harris and Smith, 1916:9.
	Canarium australasicum	Wood	Do.
	Cupania pseudorhus A. Rich	Bark	Do.
	Derris uliginosa Benth	Stalk	Hamlyn-Harris and Smith, 1916:10.
	Tephrosia rosea F. Muell	Plant	Hamlyn-Harris and Smith, 1916:12.
	Albizzia procera Benth	Bark	Hamlyn-Harris and Smith, 1916:14.
	Acacia spp	Bark, leaves	Do.
	Terminalia seriocarpa F. Muell	Bark	Hamlyn-Harris and Smith, 1916:15.
	Sarcocephalus cordatus Miq	do	Hamlyn-Harris and Smith, 1916:17.
	Asclepias curassavica L	Plant	Hamlyn-Harris and Smith, 1916:19.
	Polygonum hydropiper L	do	Hamlyn-Harris and Smith, 1916:19–20.
	Petalostigma guadriloculare F. Muell.	Fruit	Do.
	Alocasia macrorrhiza Schott	Plant	Hamlyn-Harris and Smith, 1916:20.
	Planchonia careya (F. Muell.) R. Knuth.	Bark, root	Howes, 1930:143; Hamlyn-Harris and Smith, 1916:16.
	Jagera pseudorhus (A. Rich.) Radlk.	Bark	Howes, 1930:143.
	Tephrosia astragaloides R. Br	Leaves	Walter E. Roth, 1897:95–96.
	Tephrosia rosea F. Muell		Howes, 1930:144.
	Faradaya splendida F. Muell	Bark	Greshoff III:136; Hamlyn-Harris and Smith, 1916:18–19.
Dunk Island	*Derris koolgibberah* Baill	Stalk	Howes, 1930:145; Hamlyn-Harris and Smith, 1916:11.
New South Wales	*Acacia* sp		Greshoff II:69–70.

[1] For full data, see Maiden, 1894; Hamlyn-Harris and Smith, 1916; Howes, 1930, pp. 142–146.

TABLE 7.—*Distribution of fish-poison plants in California*

Tribe	Plant	Part used	Reference
Wailaki	*Chlorogalum pomeridianum* (Ker) Kunth.	Root	Powers, 1877:117.
Kato	*Angelica* sp	Plant	Loeb, 1932:46.
	Chlorogalum pomeridianum (Ker) Kunth.	Root	Do.
Yuki	*Echinocystis oregana* (Cogn.)		Chesnut, 1902:390–91.
	Aesculus californica (Spach) Nutt.	Shoots, leaves	Chesnut, 1902:367.
Wintu	*Chlorogalum pomeridianum* (Ker) Kunth.	Plant	Du Bois, 1935:17.
	Echinocystis fabacea Naud	Root	R. K. Beardsley, MS.
	Eremocarpus setigerus (Hook.) Benth.	Plant	R. K. Beardsley, Field Report (MS.).

TABLE 7.—*Distribution of fish-poison plants in California*—Continued

Tribe	Plant	Part used	Reference
Yahi	"Squirting cucumber"	Fruit	Pope, 1918:130.
Nomlaki, Maidu	*Trichostema lanceolatum* Benth	Plant	Chesnut, 1902:385.
Maidu	*Eremocarpus setigerus* (Hook.) Benth.	do	Greshoff III:89–90.
	Aesculus californica (Spach) Nutt.	Shoots, leaves	Chesnut, 1902:367.
Tolowa	*Chlorogalum pomeridianum* (Ker) Kunth.	Root	Drucker, 1937:294.
Pomo	*Echinocystis fabacea* Naud	do	Loeb, 1926:169.
	Chlorogalum pomeridianum (Ker) Kunth.	do	Kniffen, 1939:376; Chesnut, 1902:320.
	Eremocarpus setigerus (Hook.) Benth.	Plant	Chesnut, 1902:363, 321.
	Datisca glomerata (Presl) Benth. and Hook.		Chesnut, 1902:370.
Central Miwok	*Aesculus californica* (Spach) Nutt.	Nuts	Barrett and Gifford, 1933:190.
	Chlorogalum pomeridianum (Ker) Kunth.	Root	Do.
Southern Miwok	*Aesculus californica* (Spach) Nutt.	Nuts	R. K. Beardsley, Field Report (MS.).
	Echinocystis horrida Congdon	Seeds, root	R. K. Beardsley, MS.
Wappo	*Chlorogalum pomeridianum* (Ker) Kunth.	Root	Driver, 1936:185.
	Eremocarpus setigerus Benth	Plant	Do.
Nisenan	*Chlorogalum pomeridianum* (Ker) Kunth.	Root	Beals, 1933:347; Powers, 1873:375–376, 423.
	Eremocarpus setigerus (Hook.) Benth.	Plant	Beals, 1933:347.
	Aesculus californica (Spach) Nutt.	Nuts	Powers, 1873:375–376, 423.
Salinan			J. Alden Mason, 1912:124.
Owens V. Paiute	*Smilacina sessilifolia* Nutt	Root	Steward, 1933:251.
Yokuts	*Chlorogalum pomeridianum* Kunth	do	R. K. Beardsley, Field Report (MS.).
	Aesculus californica (Spach) Nutt.	Nuts	Kroeber, 1925:529.
	Chlorogalum pomeridianum Kunth	Root	R. K. Beardsley, Field Report (MS.).
	Polygonum lapathifolium L	Plant	R. K. Beardsley, MS.
	Eremocarpus setigerus (Hook.) Benth.	do	Do.
	Trichostema lanceolatum Benth	do	Do.
Northfork Mono	*Eremocarpus setigerus* (Hook.) Benth.	do	Do.
	Umbellularia californica Nutt	Leaves	Do.
	Aesculus californica (Spach) Nutt.	do	Do.

TABLE 8.—*Distribution of fish-poison plants in the Antilles*

Area	Plant	Part used	Reference
Antilles	*Paullinia cururu* L		Radlkofer, 1887:403.
	Paullinia pinnata L		Do.
	Paullinia jamaicensis Macf		Radlkofer, 1887:404.
	Tephrosia toxicaria (Sw.) Pers		Radlkofer, 1887:405.
	Tephrosia cinerea (L.) Pers		Do.
	Lonchocarpus latifolius (Willd.) H. B. K.	Fruit	Radlkofer, 1887:406–407.
	Phaseolus lathyroides L	Juice	Radlkofer, 1887:406.
	Jacquinia barbasco (Loefl.) Mez	Leaves, fruit	Radlkofer, 1887:410.
	Euphorbia cotinifolia L		Radlkofer, 1887:413.
	Serjania polyphylla (L.) Radlk		Do.
Bahamas	*Icthyomethia piscipula* (L.) Hitchc.	Bark, leaves	Goggin, 1939:25.
Cuba	*Agave americana* L		Greshoff II:149.
Porto Rico	*Canella winterana* (L.) Gaertn		Greshoff II:20.
Dominica	*Phyllanthus brasiliensis* (Aubl.) Muell. Arg.	Leaves	Taylor, 1938:145.
	Diospyros sp	Fruit	Taylor, 1938:145; Greshoff III:129.
	Ichthyomethia piscipula (L.) Hitchc.	do	Taylor, 1938:145; Radlkofer 1887:407–408.
Jamaica [1]	*Sapindus saponaria* L	Seeds, root	Greshoff I:42.
	Euphorbia punicea Sw	Leaves, fruit	Radlkofer, 1887:413.
	Tecoma leucoxylon (L.) Mart		Radlkofer, 1887:412.
Martinique	*Clitoria arborescens* Ait.?	Bark, leaves	Radlkofer, 1887:406.
	Basanacantha armata Hook. f	Fruit	Greshoff II:88–89.
	Clibadium barbasco DC		Greshoff II:89.

[1] For further data, see Blake, 1919.

TABLE 9.—*Distribution of fish-poison plants in Guatemala, Mexico, and the southeastern United States*

Area or tribe	Plant	Part used	Reference
Guatemala [1]	*Enterolobium cyclocarpum* Gris		Wisdom, 1940:77-78.
	Zamia furfuracea L. f		Do.
	Paullinia sp	Stalk	Do.
	Polygonum acre H.B.K		Fagundes, 1935:73.
Honduras (North coast).	A wild vine	Stalk	Bancroft, 1886:720-721.
Mexico	*Gouania* sp		Greshoff I:32; Radlkofer, 1887:398, 402.
	Paullinia costata Schlecht. and Cham.		Radlkofer, 1887:398, 404; Greshoff I:40.
	Buddleia verticillata H.B.K	Plant	Greshoff II:110-111.
	Thevetia neriifolia Juss		Fagundes, 1935:74.
	Ipomoea tuberosa L	Roots	Greshoff II:113.
	Schoenocaulon officinale A. Gray		Greshoff II:152-153.
	Hura crepitans L	Sap	Rose, 1899:257.
	Hura polyandra Baill	do	Howes, 1930:138.
Chiapas, Mexico	*Jacquinea seleriana* Urb and Loesn	do	Do.
Tehuantepec	*Sapindus saponaria* L	Plant	Barnard, 1852:212.
Populuca (Veracruz)		do	G. Foster (information).
San Martin Pajpan		do	Do.
Chiltepec, Mexico		Vine stalk	Weitlaner, 1940:170.
		Root	Weitlaner, 1940:172.
Otomi, Aztec			Do.
Aztecs	*Merremia tuberosa* (L.) Rendle	Root	Greshoff II:113.
Totonac			Weitlaner, 1940:172.
Tarahumare	*Tephrosia talpa* Wats	Plant	Bennett and Zingg, 1935: 140.
	Casimiroa edulis Llav. and Lex	do	Bennett and Zingg, 1935:170.
	Casimiroa sapota Oerst	do	Do.
	Calcalia decomposita A. Gray	do	Do.
	Cracca talpa Wats	do	Do.
	Sebastiania bilocularis S. Wats	Sap	Clavigero, 1937:55.
	Polygonum sp		Lumholtz, 1903:vol. 1, p. 401.
	Agave sp	Plant	Do.
Acaxee			Beals, 1932:167.
Yaqui	*Jacquinia pungens* A. Gray	Bark	Drucker, 1941:225; Weitlaner, 1940:171.
Opata	*Sebastiana* sp (?)	Sap	Drucker, 1941:225; Obregón, 1928:172.
Pima Bajo			Drucker, 1941:225.
Baja California	*Sebastiana pavoniana* Muell. Arg	Sap	Greshoff II:144; Ten Kate, 1885:86.
	Lophocereus schotti (Engelm) Br. and Rose.	Plant	H. Aschmann (information).
	Machaerocereus gummosus Britt. and Rose.	do	Greshoff III:114; Brandegee, 1890:107.
Cocopa	*Salix* sp	Leaves	Gifford, 1933:268.
Southeastern United States.	*Aesculus* sp	Nuts	Adair, 1930:432.
Choctaw	*Aesculus* sp	do	Swanton, 1931:55.
	Ilex verticillata (L.) Gray (?)	Plant	Do.
	Tephrosia sp	do	Do.
Cherokee	*Juglans* sp	Bark	Mooney, 1900:422.
Catawba	*Juglans nigra* L	Nuts	Speck, 1934:73-74.
Yuchi	*Tephrosia virginiana* (L.) Pers	Roots	Speck, 1909:23.
Creek	*Aesculus* sp	Nuts	Speck, 1909:24.
Delaware (Okla.)	*Juglans* sp	Green nuts	Harrington, 1913:222.
	Aesculus glabra Willd	Nuts	Tantaquidgeon, 1942:25.
Florida	*Cornus amomum* Mill	Bark	Glennan, 1886:10-11.
	Piscidia communis	Roots	Killip, 1937:56.

[1] Wisdom (1940, pp. 77-78) mentions other piscicidal plants (bejuco de pescado, camote sylvestre, matapescado, zopilote, siete pellejus) but without botanical identification.

TABLE 10.—*Distribution of fish-poison plants in South America* [1]

Area	Plant	Part used	Folk name	Reference
Brazil	*Paullinia thalictrifolia* Juss.			Radlkofer, 1887: 404.
	Magonia pubescens St. Hil.	Leaves, bark.	Tingui; tingui capeta.	Radlkofer, 1887: 404; Fagundes, 1935:72.
	Magonia glabrata St. Hil.	Bark, roots.	Tingui; Timbó assú.	Radlkofer, 1887: 405; Fagundes, 1935:72.
	Centrosema plumieri (Turp.) Benth.	Bark	Guaiana-timbó?	Radlkofer, 1887: 406.
	Clitoria amazonum Mart.?	Branches	Timbó de cono?	Do.
	Camptosema (?) *pinnatum* Benth.		Gorano-timbó	Do.
	Camptosema sp.		Timbó	Do.
	Lonchocarpus rariflorus Mart.?		Taraira-moirá?	Radlkofer, 1887: 407.
	Bowdichia virgilioides Kunth		Sebipira	Radlkofer, 1887: 408.
	Bauhinia guianensis Aubl.			Do.
	Leguminosae sp.		Piracu-úba	Do.
	Gustavia brasiliana DC.	Fruit	Janiparandiba; japarandiba; japarandi; genipanara.	Radlkofer, 1887: 409; Fagundes, 1935:71.
	Ichthyothere cunabi Mart.	Plant	Cunabi; cunambi; conamy.	Do.
	Thevetia peruviana (Pers.) Schum.	Leaves, fruit.	Ahoui-guacu; jorro-jorro.	Radlkofer, 1887: 409; Fagundes, 1935:74.
	Cocculus imene Mart.		Taraira-moirá	Radlkofer, 1887: 401.
	Annona reticulata L.			Fagundes, 1935:70.
	Lonchocarpus floribundus Benth.	Plant	Timbó venenoso	Fagundes, 1935:71; Filho, 1935:19.
	Odontadenia cururu K. Sch.	do	Cipó cururu	Fagundes, 1935:72.
	Pachyrrhizus angulatus Rich.		Jacatupe	Do
	Paullinia alata (Ruiz and Pav.) Don.		Urariana	Do
	Phyllanthus piscatorum H. B. K.		Tingir de Perou	Vellard, 1941; 83.
	Annona spinescens Mart.		Anaticum do Brejo.	Fagundes, 1935:70.
	Dipladenia illustris Muell.			Fagundes, 1935:71.
	Indigofera lespedezioides H. B. K.		Timbó mirim	Fagundes, 1935:71; Vellard, 1941:83.
	Paullinia meliaefolia Juss.		Timbó peba; tingui de Folha Grande.	Fagundes, 1935:72.
	Paullinia rubiginosa Camb.		Cruapé-vermelho	Do.
	Paullinia trigonia Vell.		Tingui; timbó aitica.	Do.
	Phyllanthus cladotrichus Muell.-Arg.		Nerva de pombinha da serra.	Do.
	Phyllanthus Sw.		Conami; timbó conabi.	Fagundes, 1935:72; Vellard, 1941:83.
	Phyllanthus piscatorum H. B. K.		Tingui de peixe	Fagundes, 1935:72.
	Polygonum acre H. B. K.		Herba de bicho; cataya.	Vellard, 1941:82.
	Clibadium barbasco DC.			Fagundes, 1935:71.
	Derris pterocarpa (DC.) Killip		Timbó; timbó dematta; timbórana; timbó cipó timbó-assú.	Fagundes, 1935:71; Filho, 1935:19.
	Clibadium surinamense L.		Conami	Fagundes, 1935:71.
	Piscidia erythrina L. (?)		Timbó; timbó boticario.	Fagundes, 1935:73; Vellard, 1941:82.
	Sapindus saponaria L.		Quiti; macaacaipú; casita; jequitir-guassú.	Fagundes, 1935:73.
	Serjania communis Camb.		Timbó mêndo	Do.
	Serjania cuspidata Camb.		Timbó capelludo; timbó de peixe.	Do.
	Serjania dentata (Vell.) Radlk.		Timbó de restingas.	Do.
	Serjania glabrata H. B. K.		Tamuja	Do.
	Serjania paucidentata DC.			Do.
	Serjania purpurascens Radlk.		Timbó vermelho	Do.
	Talisia esculenta (St. Hil.) Radlk.		Pitombeira	Fagundes, 1935:74.
	Tephrosia nitens Benth.		Timbó cáa; ajaré	Fagundes, 1935:74; Filho, 1935:19.

See footnotes at end of table.

TABLE 10.—*Distribution of fish-poison plants in South America*—Continued

Area	Plant	Part used	Folk name	Reference
Brazil	*Thevetia ahouai* (L.) A. DC		Agai	Fagundes, 1935:74.
	Tripterodendron filicifolium (Linden) Redlk.		Farinha secca	Do.
	Enterolobium timbouva Mart		Orelha de preto; Timborá; timbóura.	Filho, 1935:19.
	Cleome spinosa Jacq. (?)		Tareraiya	Radlkofer, 1887: 402.
	Serjania lethalis St. Hil		Cipo de timbó; matta fomó; pehko.	Radlkofer, 1887: 408.
	Serjania erecta Radlk	Stem, leaves	Timbó bravo; cipo de timbó; turari.	Do.
	Serjania ichthyoctona Radlk		Timbó; timbó de peixe; tingui legitimo.	Radlkofer, 1887: 403; Fagundes, 1935: 73.
	Serjania acuminata Radlk		Timbó de peixe	Do.
	Serjania piscatoria Radlk		Tingi; tingui de peixe.	Do.
	Paullinia cupana H. B. K		Guaraná	Radlkofer, 1887: 404.
	Thevetia ahouai (L.) A. DC	Leaves, fruit	Ahoui-mirim	Radlkofer, 1887: 410.
	Buddleia brasiliensis Jacq		Barbasco	Radlkofer, 1887: 411; Fagundes, 1935: 70.
	Euphorbia cotinoides Miq		Gunapalu; assu-cu-i; leiteira.	Radlkofer, 1887: 413; Vellard, 1941: 83.
	Phyllanthus conami Sw	Fruit, leaves	Conami	Radlkofer, 1887: 414.
	Piranhea trifoliata Baill	Stems	Piranha-úba; pirand-úba; pyranheira.	Radlkofer, 1887: 414: Vellard, 1941: 83.
	Ruprechtia laurifolia C. A. Mey	Leaves	Timpa-pêba; timbubeba.	Greshoff III: 36.
	Paullinia australis St. Hil		Timbó; timbó de Rio Grande.	Greshoff III:102; Fagundes, 1935: 72.
	Paullinia pinnata L		Timbó; matta porco; Cururu-apé; timbó cipó; cruape vermelho.	H. W. Bates, 1892: 220–21; Fagundes, 1935: 72; Filho, 1935: 19.
	Paullinia trigonia Vell	Bark	Tingui sipo	Greshoff II: 37.
	Joannesia princeps Vell	Bark, juice	Anda, anda-assu	Radlkofer, 1887: 414; Fagundes, 1935: 71.
	Manihot esculenta Crantz	Juice, root		Radlkofer, 1887: 414.
	Hura crepitans L	Juice	Arceira; oassucu; assacú; assaca.	Radlkofer, 1887: 415; Fagundes, 1935: 71.
	Lonchocarpus nicou (Aubl.) DC	Leaves, roots.	Timbó legitimo	Killip and Smith, 1931: 407.
	Lonchocarpus urucu K. and S	Leaves, etc	Timbóurucú; timbó macaquinho; timbó rouge; timbó carajurú.	Killip and Smith, 1931: 407; Filho, 1935: 18.
	Tephrosia toxicaria (Sw.) Pers	Leaves, etc	Timbó de Cayenne; onabouboue; anil bravo.	Killip and Smith, 1931: 407.
	Tephrosia emarginata HBK			Killip and Smith, 1931: 407; Fagundes, 1935: 74.
	Clibadium sylvestre (Aubl.) Baill			Killip and Smith, 1931: 407.
	Enterolobium timboũva Mart		Timbouva	Greshoff III: 61.
	Derris negrensis Benth		Timborana; timbó guassis.	Greshoff III: 74; Vellard, 1941: 82.
	Serjania noxia Camb		Timbó de leite	Greshoff III: 105.
	Cestrum laevigatum Schlecht			Greshoff III: 139.
Guiana [2]	*Manihot esculenta* Crantz	Root		Gillin, 1936: 13–14.
	Jacaranda procera Spreng			Radlkofer, 1887: 412.
	Euphorbia cotinoides Miq		Gunapalu	Radlkofer, 1887: 413.
	Phyllanthus conami Sw	Fruit, leaves	Conami	Radlkofer, 1887: 414.

See footnotes at end of table.

TABLE 10.—*Distribution of fish-poison plants in South America*—Continued

Area	Plant	Part used	Folk name	Reference
Guiana	*Tephrosia cinerea* (L.) Pers		Sinapou	Radlkofer, 1887: 405.
	Lonchocarpus densiflorus Benth.	Roots	Hairi; bastard hairri.	Walter E. Roth, 1924: 203; Gillin, 1936 11–14; Radlkofer, 1887: 407.
	Lonchocarpus rariflorus Mart		Fai faia noroko	Archer, 1934: 205.
	Lonchocarpus rufescens Benth	Roots	Hairi	Walter E. Roth, 1924: 203; Gillin, 1936: 13.
	Clibadium asperum DC	Leaves, fruit.	Conami	Quelch, 1894: 238; Walter E. Roth, 1924: 203–204.
	Clibadium surinamense L	do		Radlkofer, 1887: 409. Walter E. Roth, 1924; 203–204.
	Tephrosia toxicaria (Sw.) Pers		Counami; yarro conalli.	Walter E. Roth, 1924: 204.
		Tree chips	Wa'u; mora balli	Gillin, 1936: 13.
	Caryocar glabrum Pers			Radlkofer, 1887: 402.
	Tapura guianensis Aubl		Bois de Goiette	Radlkofer, 1887: 403.
	Lonchocarpus nicou (Aubl.) DC.	Branches	Nicou; Inekou; "real hiaree"; heirri; haiari.	Radlkofer, 1887: 407; Greshoff III: 75–76.
	Muellera frutescens (Aubl.) Standl.		Haiariballi	Greshoff III: 76; II: 64.
	Derris guianensis Benth			Radlkofer, 1887: 407.
	Cassia venenifera Rodschied	Roots	Piami	Radlkofer, 1887: 408.
	Bauhinia guianensis Aubl		Hikuritarifon	Radlkofer, 1887: 408; Archer, 1934: 205.
	Gustavia augusta L			Radlkofer, 1887: 409.
	Clibadium surinamense L			Do.
	Serjania paucidentata DC		Ababo-	Archer, 1934: 205.
	Serjania pyramidata Radlk		Casire	Do.
	Serjania spp		Hebechiabo; kotupurru.	Do.
	Talisia squarrosa Radlk		White moruballi	Do.
	Alexa imperatricis (Schomb.) Baker.		Hairiballi	Do.
	Antonia ovata (Hook). Prog		Inyáku	Do.
	Jacquinia sp		Teterumballi	Do.
	Clathropis brachypetala (Tul.) Kleinh.		Arumatta	Do.
	Piper spp		Warakabakoro; tona.	Do.
	Pothomorpha peltata (L) Miq.		Duburibanato	Do.
	Phyllanthus conami Sw		Bois á enivrer tue poisson.	Vellard, 1941: 83.
Eastern Peru	*Tephrosia toxicaria* (Sw.) Pers	Leaves	Cube	Killip and Smith, 1931: 403; Goodspeed, 1941: 152; Tessmann, 1930: El. 22.
	Lupinus mutabilis Sweet	Plant		Killip and Smith, 1931: 403.
	Lonchocarpus nicou (Aubl.) DC.	Leaves	Cube; barbasco	Killip and Smith, 1931: 404.
	Serjania glabrata Kunth	Stalk	Verap	Do.
	Serjania rubicaulis Benth	do	do	Do.
	Serjania rufa Radlk	do	do	Do.
	Clibadium strigillosum Blake		Guaco	Do.
	Clibadium vargasii DC	Plant		Tessmann, 1930: El. 22.
Peru	*Lobelia tupa* L			Radlkofer, 1887: 409.
	Tephrosia toxicaria (Sw.) Pers		Barbasco	Herrera, 1940: 81.
	Apurimacia incarum Harms		Chancauhuai	Herrera, 1940: 86.
	Lonchocarpus nicou (Aubl.) DC.		Kumu; koubé; conapi; pacai; barbasco.	Herrera, 1940: 98; Fagundes, 1935: 71–72; Vellard, 1941: 82.
	Sapindus saponaria L		Sullucu	Herrera, 1940: 118.
	Cinchona sp	Bark		Greshoff II: 88.

See footnotes at end of table.

TABLE 10.—*Distribution of fish-poison plants in South America*—Continued

Area	Plant	Part used	Folk name	Reference
Ecuador			Tôte; barbasco	Von Hagen, 1939: 38-39.
Bolivia	*Serjania lethalis* St. Hil	Stalk	Pehko; sacha	Greshoff I: 36.
Chile	*Lobelia tupa* L			Radlkofer, 1887: 409.
Venezuela	*Euphorbia caracasana* Boiss			Radlkofer, 1887: 413; Greshoff, I: 132.
	Lonchocarpus rufescens Benth. (?).		Barbasco blanco	Ramirez, 1943: 504.
	Agave americana L			Greshoff, II: 149-50.
	Gustavia augusta L			Radlkofer, 1887: 409.
	Clibadium barbasco DC		Barbasco amarillo; barbasco; juque.	Ramirez, 1943: 504; Radlkofer, 1887: 409.
	Jacquinia arborea Vahl		Barbasco	Radlkofer, 1887: 410.
	Bryrsonima crassifolia H. B. K	Branches	Chaparro de Manteca.	Greshoff, II: 27-28.
	Cusparia trifoliata (Willd.) Engl		Cuspa	Greshoff II: 29.
	Polygonum glabrum Willd		Barbasco; chiguirera.	Vellard, 1941: 82; Ramirez, 1943: 504.
	Piscidea guaricensis Pittler		Borracho; jebe, barbasco amarillo; barbasco jaune.	Vellard, 1941: 82; Ramirez, 1943: 504.
	Ichthyothere terminalis (Spreng.) Blake.		Galicosa; jarilla; dictamo real.	Vellard, 1941: 84.
	Tephrosis toxicaria (Sw.) Pers	Root	Barbasco de raiz; kouna.	Vellard, 1941: 82-83; Ramirez, 1943: 504.
	Tephrosia cinerea L		Sen senextranjero; barbasco blanc.	Ramirez, 1943: 504; Vellard, 1941: 83.
	Hura crepitans L		Jabillo; ceibo blanco.	Vellard, 1941: 83.
	Phyllanthus piscatorum H. B. K		Barbascayo	Ramirez, 1943: 504; Vellard, 1941: 83.
	Jacquinia aristata Jacq		Barbasco; olivo; chilca; chirca.	Ramirez, 1943: 503; Vellard, 1941: 83.
	Jacquinia revoluta Jacq			
	Jacquinia mucronulata Blake			
	Jacquinia armillaris Jacq			
	Indogifera suffruticosa Mill		Añalito; Raiz de la virgen.	Ramirez, 1943: 503.
	Piper riolimonense Trel		Raiz de muela	Ramirez, 1943: 504.
	Thevetia peruviana (Pers.) Schum.		Caruache; cascabel; lechero; cruceta real.	Velland, 1941: 84.
Costa Rica	*Serjania inebrians* Radlk		Barbasco	Radlkofer, 1887: 403.
Panama	*Piper darienense* C. DC	Leaves	do	Radlkofer, 1887: 412.
Cayenne	*Lonchocarpus densiflorus* Benth	Roots		Roth, Walter E., 1924: 202.
	Lonchocarpus rufescens Benth	do		Roth, Walter E., 1924: 203.
	Lonchocarpus nicou (Aubl.) DC	do		Roth, Walter E., 1924: 203.
Argentina	*Polygonum acre* H. B. K		Caa tay	Vellard, 1941: 82.
Paraguay	*Polygonum acre* H. B. K		Yerba picante	Do.
	Cardiospermum grandiflorum Sw			Do.
	Thinouia paraguayensis Radlk			Vellard, 1941: 83.
Surinam [3]	*Phyllanthus conami* Sw	Leaves	Barbasco	Greshoff III: 87.
	Tephrosia toxicaria (Sw.) Pers	Plant	Wanamoe; doekali; koenamie.	Greshoff III: 71, 76, 94.
	Lonchocarpus violaceus H. B. K		Nekoe; Hojali	Greshoff III: 76.
	Euphorbia cotinoides Miq		Koenapaloe	Greshoff III: 76, 94.
	Lonchocarpus densiflorus Benth	Roots		Roth, Walter E., 1924: 203.
	Lonchocarpus rufescens Benth	do		Roth, Walter E, 1924: 203.
	Lonchocarpus nicou (Aubl.) DC	do	Neka	Roth, Walter E. 1924: 203; Vellard, 1941, 82.

See footnotes at end of table.

Table 10.—*Distribution of fish-poison plants in South America*—Continued

Area	Plant	Part used	Folk name	Reference
Surinam	*Serjania inebrians* Radlk.	Vine	Barbasco	Conzemius, 1932: 70.
Colombia	*Tephrosia toxicaria* (Sw.) Pers.	Roots	do	Wassen, 1935: 103–104.
	Derris elliptica (Roxb.) Benth.	do		Santesson, 1935: 25.
Tropical America.	*Sapindus saponaria* L.	Leaves	Sapo indicus; jaboncillo.	Radlkofer, 1887: 404.
	Nissolia fructicosa Jacq.			Greshoff II: 53.
	Polygonum acuminatum H.B.K.			Vellard, 1941: 182.
	Cassia semperflorens DC.			Greshoff III: 64.

[1] See Métraux, 1928; Nordenskiöld, 1920; Killip and Smith, 1930, 1931, 1935; Radlkofer, 1887; Lowie, 1940; Howes, 1930, pp. 134–38; Roark, 1936, pp. 19–27; 1938, pp. 23–24.
[2] See also Archer, 1934; Martyn and Follett-Smith, 1936.
[3] For further data, see Borst Pauwels, 1903 a, 1903 b.

NOTE

Since the present paper was written a dozen years ago much new information on the subject has appeared. Although it is not feasible to cite all the recent additions to fact, a few references have been added to the bibliography in galley and others are cited here.

Rostlund's preliminary paper of 1948 has been followed by a recent monograph (Rostlund, 1952) which deals extensively with fresh-water fish and fishing in aboriginal North America. Rostlund discusses the physical environment of fish poisoning as a culture trait (pp. 127–129), a subject which I have here only mentioned. His distributional data (pp. 129, 130, 188–190, map 39) agree with mine in showing two major and disparate areas of fish drugging, California and the Southeast. Eschewing speculation on the possibility of historical connection between the two areas, Rostlund (pp. 131–133) considers the possibility of historic introduction of fish poisoning in the Southeast through Europeans or African Negroes. The idea is a good one, and I did not see it. In addition to the Southeastern tribes listed here in table 9 as employing piscicides, Rostlund cites the Chickasaw. More northerly tribes cited by him include the Penobscot, Iroquois, Delaware, Nanticoke, Powhatan tribes (?) and Sauk. Rostlund discusses and rejects the hypothetical circum-North Pacific route of introduction of fish poisoning to North America.

R. H. Lowie (1951, pp. 18–20) has discussed some generalities of fish drugging in world perspective and as illustrative of certain cultural processes.

G. Hewes (1942) in a study of northern California fishing has plotted the distribution of fish poisoning, and a useful note by McFarland (1951) further supplements the data on California Indian piscicides.

R. F. H.
May 1952.

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JÍVARO INDIANS POISONING FISH.
(Photograph by E. P. Killip.)

JÍVARO INDIANS COLLECTING STUPEFIED FISH.
(Photograph by E. P. Killip.)

South American Indians Poisoning Fish, Fortaleza, Near Yurimongas.

PLANTATION OF FISH-POISON PLANTS, FORTALEZA, NEAR YURIMONGAS.