ORIGINAL ARTICLES

POISONOUS PLANTS OF INDIA

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Introduction

IT is admitted on all sides that the country in which we live is a veritable emporium of drugs containing powerful active principles. Nearly three-fourths of the drugs mentioned in the British and other pharmacopœias grow in a state of nature here and the others can be easily grown. The country has vast resources so far as medicinal plants are concerned, and it abounds in many kinds of perfumes and spices which are known all over the world. India possesses climatic conditions varying from the torrid to the frigid zone. It embraces vast tracts of tropical plains, temperate hills and valleys, irrigated soil, and moist and dry climates. It has in fact been described as an epitome of the climates, seasons and soils of the British Empire. No wonder then that the plants containing active and medicinal principles grow abundantly within its bounds. More than 2,000 such plants have been enumerated in the literature of the indigenous systems of medicine which are alleged to have medicinal properties of some description or other and have been used in indigenous medicine in some form or other. The majority of these plants have not yet been fully investigated.

Many among them are said to contain powerful and toxic principles. If introduced into the body of an animal in relatively small quantities, they will act deleteriously and may cause serious impairment of bodily functions or even death. They injure the basic life principle, the protoplasm of the cells of which the animal body is built up, by virtue of their chemical constituents whose nature may be known or unknown. Such a definition of poisonous plants would exclude plants which act entirely in a mechanical way, such as certain grasses notably *Stipa*, *Aristida* and *Heteropogon*, whose 'seeds' may pierce the skin and produce abscesses or make their way into the salivary ducts of animals and do serious injury; nor would it be desirable to include spiniferous plants which do considerable harm to man and animals. On the other hand, it will include some foodstuffs or fodder plants which may

become deleterious under certain conditions. The harmful effects produced by chemical substances contained may be immediate or cumulative, i.e. they may appear after a period of time when the poison has had time to accumulate in the body in sufficient concentration to produce its deleterious effect after repeated administration. All such plants come under the category of poisonous plants.

Chemical constituents of plants responsible for toxic effects

(1) The first class of these substances are vegetable bases which include amines and alkaloids. As a class these bodies are characterized by their profound physiological action and in many cases their intensely poisonous nature. Some of the amines give a foetid odour to some weeds, and to some mushrooms their poisonous characters. The alkaloids as a rule give a bitter taste to a plant in which they naturally occur, and that in itself is frequently a sufficient protection against livestock eating it, except in unusual cases of hunger. A considerable number of medicinal drugs owe their curative properties to these principles. The grasses as a rule do not contain these bases but they do occur in many of the other families. Examples of alkaloids are strychnine from nux-vomica, aconitine from aconites, atropine and allied alkaloids from belladonna, nicotine from tobacco, morphine from poppy, etc.

(2) Another class of poisonous substances are represented by glucosides which form a large group and are much wider in occurrence than alkaloids. Many are non-toxic but quite a large number of them are intensely poisonous. They have generally a bitter taste and occur in many of the plant extracts used in medicine. Well-known examples of toxic glucosides are those occurring in the Oleander family (*Apocynaceæ*) and *Digitalis* (*Scrophulariaceæ*).

A group of glucosides which are important from the point of view of livestock-poisoning is represented by the cyanogenetic glucosides which contain hydrocyanic acid bound up in them ; this is liberated by enzymes mostly occurring in the same plants. As the name implies they split in the animal body, liberating sufficient quantities of hydrocyanic acid to produce fatal results. The well-known representative of this class is one occurring in bitter almonds and known as amygdalin. They also occur in a number of grasses and members of the pea and rose families, etc.

Another group of glucosides, when agitated with water, produce soapy foam and to these the name of saponins is given. In the vegetable kingdom they occur in at least 400 plants belonging to 50 different families. They are particularly poisonous to certain lower animals, for example fishes, frogs, insects, etc. The fish are killed by these bodies in such high dilutions as 1 in 200,000 or more. In higher animals, when taken by mouth, they produce gastro-intestinal irritation, vomiting and diarrhœa. In cold-blooded animals, such as fishes, they produce paralysis of the respiratory organs. They produce hæmolysis when they come in contact with blood and have an acrid taste. Common examples containing saponins are soap-nut, soap-bark and soap-root.

(3) The third group of poisons is furnished by essential or volatile oils which give characteristic odours to plants. These bodies are characterized

by their insecticidal and insect-repellent properties, while in man and livestock they produce toxic effects by gastro-intestinal irritation. Common examples are those occurring in eucalyptus, in absinth which produces convulsions by its action on the nervous system, the pine family and that produced from mustard seed by the action of an enzyme, etc. Cattle do not as a rule feed on the plants containing the toxic essential oils.

(4) The fourth group of toxic substances are known as toxalbumins which occur in castor, croton and abrus seeds. These are essentially blood poisons and are responsible for frequent losses among livestock. Animals can, however, become immune to these bodies if they are given in small and gradually increasing doses, but the immunity is of a specific nature, i.e. against that particular toxalbumin and not against others.

(5) Lastly there are groups of substances called resins such as those occurring in podophyllum, bitters such as are found in wild members of the cucumber family, for example colocynth, phenolic compounds such as those found in many members of the cashew family. Other highly toxic principles are andromedotoxin occurring in many members of the rhododendron family, toxic oils such as croton oil, picrotoxin, a convulsant poison found in *Anamirta cocculus* (Linn.) W. and A. (poison berry) which is a climbing shrub of the Indian forests, and neutral principles, organic acids and their salts, etc. All these have been responsible for poisoning in man and animals.

Factors affecting toxicity

The amount of poisonous substances present in plants is dependent upon several factors, for example the nature of the soil, the climate, the season, the stage of growth of a plant, the nature and intensity of light, cultivation, etc. Fresh, green plants may be poisonous and in a dried condition the toxicity may be lost, for example in buttercups and other plants which have volatile active principles. Toxicity may be lost by cultivation as in the case of gourds, while the toxic principles in cinchona and oleander do not deteriorate through cultivation. The stage of growth of a plant is perhaps the most important factor in determining its toxicity.

Susceptibility of animals to plants varies enormously. Rabbits are insensitive to the atropine group and birds stand large doses of strychnine. Young mammals are generally more susceptible than old. The condition of the animal, personal idiosyncracy, tolerance and immunity also play a part in determining the degree of susceptibility to the poison.

To endeavour to compass within this paper even a comprehensive bird's eye view of poisonous plants of India would be impossible. Our object is to put before the reader as briefly as possible the importance of this work from its economic and toxicological aspects in relation to man and lower animals.

Toxicological aspects

I. Cryptogams (the flowerless plants)

The toxicological aspects of the cryptogams are very little known so far as India is concerned and we will make only brief reference to them.

(*a*) *Bacteria*

The bacteria are among the simplest form of plant life and are met with universally. The majority of them are harmless but some are injurious to man and animals. They produce deleterious effects in two ways: Firstly as parasites, when they derive their nourishment from living animals and many of them produce, within the body, toxins which are harmful. Secondly many saprophytic bacteria produce poisonous substances, especially such as those occurring in putrid flesh, fish and other decaying organic matter. It is not our intention to include them in this paper as, although they belong to the vegetable kingdom, they are a class by themselves and do not come under the category of poisonous plants.

(*b*) *Algæ*

The algæ that cause poisoning are mostly those which are found in stagnant waters. The normally offensive odour may be sufficient to indicate their presence, but only a microscopic examination can determine just what the forms of algæ present may be. Blue-green algæ, as a group, are perhaps the most pronounced in their toxic effect. Prof. Parker and other workers have shown that when odours in water are pronounced, the microscopic, organisms are present in considerable numbers. According to him, of the organisms which produce objectionable and deleterious qualities in waters, the microscopic ones are the more important and very few cases have been observed in which really serious trouble in water supplies could be attributed directly to the growth of larger plants. In any study of the algæ from this point of view, however, account must be taken of the products of decomposition by the associated bacteria since poisoning may be produced by the toxins produced by bacteria rather than by the algæ.

Certain algæ, such as *Microcystis flos-aquæ* (Wittr.) Kirch., *Aphanizomenon flos-aquæ* (Linn.) Ralfs. and species of *Anabæna*, etc. form on the surface of water what is generally called water bloom. The presence of water bloom on the surface of lakes, ponds, and other open sheets of water is distasteful to bathers and obnoxious to those living in the vicinity. Livestock compelled to drink water containing water bloom are reported to have been poisoned. In Minnesota, (U. S. A.) during recent years, horses, cattle, sheep, and turkeys have died in large numbers on the shores of lakes where water bloom is present. All the above-mentioned algæ forming water bloom have been recorded in various parts of India but no work has been done in connexion with their toxic effects. According to Dr Bhardawaja of the Benares Hindu University, water blooms containing these species occur commonly on the surface of many temple tanks in different parts of India. Of the other possibly harmful algæ may be mentioned species of *Nodularia*, *Clathrocystis*, *Nostoc*, *Oscillatoria*, *Pandorina*, and *Volvox* when present in large numbers.

The question of growth of algæ in water reservoirs leads us to a very important public health problem. Although in India very little information is available about the contamination of the water supplies with the group of toxic algæ, we cannot pass over this important question without drawing attention to the importance of checking their growth in the reservoirs of water

supplies. One of the essentials of the algal growth is light. Their growth may, therefore, be prevented, or at any rate considerably reduced, by covering up the reservoirs and cutting off sunlight. Unfortunately, most of the reservoirs for the supply of water to both animals and man in India are generally not covered and are often largely contaminated with algal growth. The removal of organic matter by keeping the source of water supply in as pure a state as possible will no doubt keep down the algal growth but it must be understood that nearly all water contains sufficient organic matter for the growth of algæ, especially the water coming from water-sheds. Growth of algæ can also be successfully prevented by the addition of copper sulphate in dilutions of one in five millions or even higher. This does not render the water deleterious to man and animals.

The problem of toxic algæ is important and deserves the attention of workers in this field.

(c) *Fungi*

i. Some fungi live on the skin and mucous membranes of man and animals and cause various diseases, e.g. ringworm, thrush, etc.

ii. There are others which attack foodstuffs and among these may be mentioned: (1) *Smuts.* Many of these are destructive parasites which invade plants of vital economic importance, such as oats, wheat, millet and other cereals. Some are supposed to be poisonous if taken in large quantities, and others are said to produce irritation of the mucous memberane. There is difference of opinion with regard to the injurious effects produced by particular kinds of smut and hardly any authentic information is available regarding those occurring in India. The subject deserves careful investigation by mycologists. (2) *Rusts.* Annual recurrence of the outbreaks of rust attacks of cereals in India, especially those attacking wheat, is of great economic importance to the country. These, especially the uredo stage, produce inflammation of the mucous membrane of the mouth and nose. The dust coming from the infested straw when the grain is thrashed is stated to cause serious disturbances of the respiratory tract. Very little information is available about the Indian strains. (3) *Ergot*, which grows on rye, is a well known example of a fungus which produces highly poisonous substances, but there is no evidence of its occurrence in India. (4) The poisonous nature of the seeds of darnel (*Lolium temulentum* Linn.), a grass and annual weed of cultivation, especially up-country, is believed to be due to a fungus, and cases of poisoning due to admixture of the seeds with wheat grains are not infrequently reported in India and abroad. Cases of death among livestock have also been reported. The animals should not be allowed to feed on the plants when seeds are formed.

(5) Very variable data are available as regards the poisonous effects of mouldy foodstuffs in India but there appears to be little doubt that the presence of certain species may occasionally produce harmful effects in man and animals. Species of *Mucor*, *Aspergillus*, *Penicillium* and *Fusarium*, etc. deserve special investigation in this connexion. It appears, however, that there is an appreciable difference in the susceptibility of different species of animals to the effects of mouldy foodstuffs. In general it has been stated

that horses, dogs and pigs are more susceptible than ruminants and poultry, while in other animals the case may be the reverse. Very little information is available about the toxicity of moulds occurring in India and the problem requires a thorough investigation because of its great economic importance. In the meantime it would be safer to consider all fungus-infected foodstuffs as deleterious. Acute poisoning with the moulds is rarely met with and if they are taken in small quantities there is hardly any danger. The practice of throwing away mouldy pickles and other edible substances is no doubt a step in the right direction.

iii. The third group of the poisonous fungi belong to the mushroom class. A number of these are edible and many occurring in India are indiscriminately eaten. Cases of fungus poisoning, therefore, are not infrequently met with, particularly in the hills. Unfortunately very little information is available about the poisonous fungi growing in this country and in spite of cases of poisoning, little attention has been paid to the subject.

Stropharia semiglobata (Batsch) Quel. from Khasia hills, *Hypholoma fasiculare* (Huds.) Fr. from Darjeeling and Simla and *Lactarius vellereus* Fr. from Sikkim are regarded as poisonous. There is also evidence on record that there exists in Bengal a fungus which closely resembles an edible form but which contains amanitine or muscarine, the poisonous principle of the foreign *Amanita muscaria* Pers. Recently two mushrooms were sent to us from Kumaon as being poisonous. These were identified as *Collybia* and *Cantharellus*. There are probably many more poisonous species than have really been incriminated as poisons, but on the whole their number may be small and indeed if properly cooked only a few are dangerous. If washed in water and macerated in vinegar before cooking, and if eaten with plenty of bread there is almost no danger in most cases. The safest method, however, is to learn to recognize the edible species and never to eat a fungus until its identity is certain.

Some of the foreign poisonous fungi, e.g. *Lepiota cristata* Quel., *Volvaria gloicephala* Gill., *Amanita muscaria* Pers. and *Amanita phalloides* Secr. are well known. The last-mentioned is responsible for perhaps 90 per cent of the deaths caused by fungus poisoning in Europe, Great Britain, and U. S. A. During the world war, when food scarcity became acute in Germany and Austria, poisoning from fungi appreciably increased. According to Ford there are four main types of mushroom intoxication: (1) Gastro-intestinal in which the attack ceases when the stomach is emptied. (2) General catharsis which is painless. (3) Violent vomiting and pain but no involvement outside the gastro-intestinal tract. (4) Choleriform type producing widespread degeneration of cells.

(*d*) *Lichens*

Very little is known about these symbiotic organisms which consist of algal cells enveloped by the mycelium of the fungus forming a felted mass. Although this group is not to be regarded as a serious menace to livestock, cases of poisoning due to *Parmelia* and *Cretraria* species, etc. are mentioned in foreign literature. *Parmelia molliuscula* has been said to affect sheep and cattle, producing lack of coordination of the hind limbs. In more severe cases

the animal lies down and is unable to move either its front or hind limbs. Little or no information is available about lichens in India and even their systematic botany has not been sufficiently worked out.

(e) *Bryophyta* (*liverworts and mosses*)

This is the least-known group of plants from the view-point of poisoning and we have, therefore, nothing to say about it.

(f) *Pteridophyta* (*vascular cryptogams*)

This group includes ferns and allied plants, and unfortunately little or no work has been done in India with regard to their toxicity. Greshoff and others have reported the presence of hydrocyanic acid in a number of ferns, especially when young. References to the supposed poisonous properties of the bracken (*Pteris aquilina*) have appeared in the literature for a long time, and Stockman in Great Britain showed that it is poisonous to cattle when eaten in considerable quantities. The plant is found in India. *Aspidium filix-mas*, the male fern, is suspected of being poisonous. The roots are used in medicine and large quantities of it produce hæmorrhagic gastro-enteritis, tremors, weakness, stupor, coma, acute nephritis, and cystitis. Six drachms of the oleoresin have proved fatal in man and three ounces in the cow. This fern is not found in India, but since there are several other foreign species of *Aspidium* which are also suspected of being poisonous it may be worth while to examine Indian representatives of these plants. Some foreign species of *Osmunda*, *Davallia* and *Adiantum* are also suspected of being poisonous, but nothing is known of Indian representatives of these ferns.

Some of the foreign species of *Equisetum* (horsetail) have long been recognized in foreign countries as injurious to cattle and horses. They produce an intoxication in which the animals stagger about and wander aimlessly. There is no information available in India with regard to the Indian horsetail, *Equisetum arvense*, but several European and American workers are convinced that it is definitely poisonous to horses, while others hold a contrary opinion. This plant grows commonly in certain places in India where it might be a menace to livestock.

II. Phanerogams (the flowering plants)

After having given a very brief survey regarding the toxicological aspects of the Cryptogamic flora we will now take up the Phanerogams. Economically this is the most important group both for man and animals from the point of view of everyday necessities of life, *e.g.*, food, medicines, etc. It is probably on account of this that more information is available with regard to this group.

From a toxicological point of view the Phanerogams may be divided into two main groups.

i. Plants poisonous to man and livestock

(*a*) *Poisonous to man.*—Primitive man in his quest for food must have come across plants containing poisonous principles by accident and by experience must soon have learned to avoid them. He even made use of them

for the purpose of fighting against his enemies and for procuring his food by killing animals with them. Many of the forest tribesmen of India, numbering 18 millions, use these poisonous plants to fight their enemies and to kill game. Among the civilized, poisoning by accident, ignorance or intention is met with even at the present time. On the whole, our knowledge is fairly well advanced so far as the relationship of poisonous plants to mankind is concerned.

Some poisonous plants have been used for criminal purposes, but the majority of them are used as medicinal agents for the amelioration of human suffer'ng. It is well known that many plants, that are harmful to life in large quantities, produce remarkably beneficial effects in small regulated doses. There is no doubt that in a country like India with a luxuriant flora, cases of poisoning with unknown plants do occur, but these are not common. From the economic point of view, the abundance of this group of plants in our midst is of very great importance inasmuch as it provides us with medicinal agents of every description, not only sufficient for our own use but also for purposes of export.

(*b*) *Poisonous to livestock.*—The second important aspect of these plants is in connexion with poisoning of livestock and here, as compared with other countries, our knowledge is very meagre. In India, there are hundreds of plants that are intimately connected with the food supply of roughly 220 millions of the bovine population out of a total of about 730 millions in the whole world. The fodder supply for this livestock amounts to at least 33 million maunds daily (excluding the concentrates that are in use). Even in its present unsatisfactory condition, the cattle industry contributes approximately 10,000 million rupees to the annual agricultural income of 20,000 million rupees of this vast country. Unfortunately no figures are available of the loss suffered through poisoning with plants in India, but we believe these must be enormous. It may be interesting here to give the example of two states, Montana and Colorado in the United States of America which may give us some idea of the possible damage. In that area it has been computed that the loss caused to the livestock industry by plant poisoning is in the neighbourhood of 200 million dollars annually. This is a very large figure considering that the size and extent of these states, as compared with India, is less than one-sixth, and also considering the fact that the knowledge of the poisonous plants there is well advanced and preventive measures are in vogue.

Though the number of plants which have markedly poisonous properties is perhaps small compared with the total species included in the Indian flora, there are many which are of common occurrence and which no doubt produce serious losses by death or illness among sheep, cattle and other domestic animals. The toxic effects produced may be indicated by reduction in the yield of milk, the milk may become unpalatable through excretion in it of toxic products, or it may even become poisonous (e.g. in the case of nux-vomica) and thus become unfit for consumption. The flesh of the poisoned animals, with the exception of the part where the poison has been introduced (e.g., by arrow wound) generally remains edible, though the viscera, especially the excretory organs, have to be discarded.

It may be stated here that animals do not instinctively select toxic plants as forage, that all classes of livestock are not necessarily equally susceptible to the same poisonous plants, that not all poisonous plants are dangerous from their initial appearance up to maturity and that in some cases the animals do acquire a depraved appetite for harmful plants, especially when the fodder supply is scarce, a condition which is of frequent occurrence in many parts of India. The losses in many cases may be avoided by increasing our knowledge about these plants by a systematic study and by working out practical preventive measures.

Prevention.—The question arises as to what should be done to prevent poisoning by plants. The adage ' prevention is better than cure ' is applicable to the problem of plant poisoning with just as much force as in other spheres. Often cases are brought to notice when the symptoms have developed and the poison has already circulated in the blood stream and done irreparable damage to the system. Increased knowledge of the poisonous plants is the first step in this direction and this is sure to have an effect in decreasing fatalities among human beings and livestock. Keeping the animals away as far as possible from dangerous areas and exercising special care during periods of drought are likely to decrease the mortality amongst livestock. Eradication of poisonous plants is a difficult matter, involving an enormous amount of labour and capital, but wherever and whenever possible it should be resorted to. This depends upon the habits of the particular plant. Such plants may be annual, biennial or perennial herbs, or shrubs or trees. Annuals complete their life-cycle within one year ; these should be pulled out or dug out before seeding. Biennials require two years to complete their life-cycle, growing one year, and flowering and fruiting in the second ; these may be dealt with as the annuals. Perennial herbs last several years, not perishing normally after once flowering and fruiting ; the above-ground portion dies each year, the root persisting. These are propagated both by the seeds and by the underground organs, such as tubers, rootstocks, bulbs, etc. and may be dug out if not deeply rooted. Shrubs are woody perennials and should be cut down or dug out. Cutting down of lower branches of trees within the reach of animals or children is advocated.

The indiscriminate importation of ornamental plants has recently increased the number of poisonous plants in India. Some of these do not find much competition in their adopted home and are spreading or are likely to spread in this country at an enormously rapid pace. The time perhaps is not yet ripe to agitate for a law prohibiting the importation of poisonous plants for gardens or to take measures to forbid the cultivation of those already introduced, but sooner or later it may have to be considered. In the meantime an appeal may be made to the good sense of the people to limit such practices as far as possible. The cuttings should not be disposed of in such a way as to be accessible to livestock.

The foodstuff dealers should make sure that adulteration is not practised either with poisonous plants or with plants whose properties are doubtful. Recent work in connexion with the causation of epidemic dropsy at the School of Tropical Medicine, has shown that in some epidemics mustard

oil adulterated with *katakar* oil from the seeds of *Argemone mexicana* Linn., the mexican poppy or *shialkata*, was the cause of the outbreak. Experimental work on human volunteers showed that food cooked in oil containing known quantities of argemone oil produced symptoms of gastro-intestinal irritation, oedema and cardiac involvement closely resembling those found in epidemic dropsy. The active principle present in this oil has a cumulative effect, and provided a sufficient quantity of the oil is consumed, symptoms appear even though the consumption of the argemone oil or incriminated mustard oil is stopped. From the evidence available it is clear that the adulteration of mustard oil with argemone oil may or may not be intentional on the part of those who grow mustard seeds or those who express or sell the oil. The plant *Argemone mexicana* grows abundantly and its seeds bear a superficial resemblance to the mustard seeds.

Food poisons.—In connexion with this group, the question of food poisons is of special significance and it will not be out of place to cite a few instances.

1. *Khesari dal, Lathyrus sativus* Linn., an important article of diet in man and animals, has been responsible for a large number of cases of poisoning under certain conditions in man, cattle, sheep, pigs, horses, pigeons, ducks, etc. Examples of lathyrism in man in the form of spastic paralysis are commonly seen every day in the streets of Calcutta and its toxic effects in horses and cattle are well known. Moderate amounts of this pulse can be taken with impunity. It is only if large amounts are taken, especially to the exclusion of other fodders or foods, that the untoward symptoms develop.

2. Grasses (*Gramineae*) form an important part of the food of animals. Some of these develop dangerously large quantities of hydrocyanic acid under certain climatic and soil conditions, especially at times of drought or when the plants are wilting, stunted or young. Unfortunately our knowledge of Indian grasses in this connexion is meagre and it is not possible to estimate the losses in livestock from this source. From some of the recent work done it would appear that quite a number of these grasses may be dangerous under conditions that still need to be investigated in India. The examples are *jowar* (*Sorghum vulgare* Pers.), the Indian millet, which is largely cultivated in this country as fodder for cattle and also for human food. It has caused serious outbreaks of poisoning among livestock when wilted or stunted under drought conditions. *Sorghum halepense* Pers., a tall perennial grass with creeping rhizomes and numerous suckers, known as Johnson grass, grows all over India under the name of *baru* in Hindi and *kala-mucha* in Bengali. It has been responsible for serious losses among livestock during recent years in the N.-W. F. Province where it is known as *dadam*. It has been stated that the amount of hydrocyanic acid in these plants decreases with the age of the plant but never entirely disappears. The points to be remembered about these grasses are that they are dangerous during wilting and under conditions of drought, that younger and more succulent ones are often more likely to contain lethal doses of hydrocyanic acid and, that, if well dried, these plants are generally not dangerous. The toxicity in the case of cyanogenetic compounds depends on the quantities of hydrocyanic acid liberated, and according to the amount and speed at which they are eaten. Often such large quantities are given that the animal

will die before any veterinary aid can be given. The only remedy is prevention. The problem of poisonous grasses is of great economic importance in certain parts of India where rains often fail and drought conditions prevail. In the recent famine in the Hissar district of the Punjab there is little doubt that in addition to ravages caused by scarcity of food, the livestock must have suffered enormously from this source.

(3) The linseed plant, *Linum usitatissimum* Linn., contains a cyanogenetic glucoside, the maximum amount of which is reached very early in the development of the plant and finally disappears, except in the seed, which still contains small quantities. An oil is expressed from the seeds and the remaining cakes are used to feed livestock. Cases of poisoning have been frequently reported amongst animals feeding on this plant. It is unsafe to feed the cattle on the immature plant, especially when it is wilted. The cake after extraction of the oil should be treated with boiling water to destroy the enzyme responsible for liberating hydrocyanic acid from the glucoside, and should not be soaked in cold water overnight. It should be given only in small quantities at a time.

(5) The mustard cake which is fed to cattle after the extraction of oil may produce chronic irritant poisoning, colic, lassitude, etc., if fed in large amounts and over prolonged periods, on account of the liberation of an essential oil by the action of an enzyme on the glucoside contained therein. The danger seems to be less in the case of *sarson* seeds than in the case of *rai* or black mustard. If boiling water is poured over the crushed cakes the enzymes are destroyed and the cakes become safe.

(6) Several members of the cucumber family (*Cucurbitaceae*) are edible but bitter varieties are occasionally met with. The latter have a strong purgative action and should be discarded. Incidentally it may be remarked that most of the wild members of the family are toxic. Colocynth which is a powerful intestinal irritant is a familiar example. The bitter members of this family have more or less a similar action.

(7) The leaf-blades of rhubarb (*Rheum* sp.) may give rise to nausea, violent vomiting, purging and abortion on account of having a high percentage of oxalic acid or oxalates in them, while no such cases have been reported from eating the leaf-stalk. The fresh leaves of beet-root (*Beta* sp.) have also produced poisoning in livestock on account of the presence of oxalates.

(8) The potato, *Solanum tuberosum* Linn., when sprouting, produces dangerously large quantities of the toxic alkaloid, solanine, and must be thrown away.

(9) Certain plants, such as buck-wheat (*Fagopyrum esculentum* Moench) which is largely cultivated for human and animal consumption, under certain conditions not yet fully understood, become toxic and give rise to inflammatory swellings of the face, eyelids and ears.

ii. Plants poisonous to insects and fishes

(*a*) *Insecticidal and insect repellent plants.*—The second group of these plants are those which are poisonous to insects and pests which do incalculable harm to man in many ways. The finding of cheap insecticides for

the diverse needs of agriculture, destruction of household pests, prevention of vectors of such diseases as malaria and many others borne by insects is a very important problem and one to which a good deal of attention has been paid in recent years. It would be no great exaggeration to say that insects have been responsible for more loss of life and destruction of property than that caused by wars, floods, earthquakes, fires and famines in the history of man. Advance in civilization is producing conditions suitable for insect multiplication in many places, in spite of all efforts to the contrary. On a moderate computation the annual loss caused to India through insect pests has been put at 2,000 millions of rupees and over a million and a half of human lives. An effective defence against these enemies of social and economic progress will materially reduce this enormous wastage and facilitate national development. One of the necessities for combating this menace is to find cheap and effective insecticides, commensurate with the means of the great masses in India whose economic condition is very low. At the present time our knowledge of plants bearing insecticidal properties in this country is very meagre indeed. A thorough enquiry into this aspect of poisonous plants is, therefore, of prime importance to the country. For several reasons vegetable insecticides are preferable to the mineral ones, such as arsenicals, copper compounds, mineral oils, etc. Those from vegetable sources are undoubtedly less deleterious to human beings and other warm-blooded animals generally and they are also less harmful from the point of view of agriculture. Most of the mineral insecticides at the present time are imported from foreign countries and are therefore expensive. So far as the insecticides from the plant kingdom are concerned, so little is known in this country that we have to depend on those growing in other countries. The larger the number of effective insecticides we discover from among our poisonous plants the greater will be the chances of their being brought into extensive use by the people for medical, veterinary, agricultural and household purposes.

Of the vegetable insecticides of proved value may be mentioned *Chrysanthemum* (*pyrethrum*), *Derris* (tuba-root), *Nicotiana* (tobacco), *Tephrosia*, *Picrasma* (quassia), *Delphinium* (larkspur), *Veratrum*, etc. Attemps are now being made to cultivate *pyrethrum* in India on account of its effectiveness in destroying insects and mosquito larvae. *Derris elliptica* Benth. is found to a very limited extent in India, but several allied species found here are worth investigating. Of these *Derris ferruginea* Benth. has been recently shown to contain rotenone and may prove to be a good insecticide. Tobacco is largely cultivated in India. *Tephrosia vogelli* Hook. *f.* has been shown in foreign countries to be an efficient insecticide for fleas, lice and ticks and it has been suggested that it may be used as a cheap commercial dip for cattle. Some of the other species of *Tephrosia* are also stated to have insecticidal properties, but several of the Indian species although met with in abundance remain uninvestigated. Indian species of *Picrasma* also need investigation and we have been informed that powdered young leaves and twigs of *P. napaulensis* Benn. are used to kill mosquito larvae in Assam. Several Indian species of *Delphinium* are already used for destroying maggots in wounds and may be potential insecticides. Furthermore it has been stated that the alkaloid cytisine is an important constituent of the Persian and Australian

insect powder. This alkaloid, which resembles nicotine in its action, has been found in at least six genera of which *Euchresta* and *Sophora* are represented in India.

Hackett, Russell and others (Bulletin of the Health Organisation, League of Nations, 1938) discuss the naturalistic methods in practice for the control of mosquito larvae and refer to the role of the plant kingdom for this purpose. It is stated that pollution by vegetable matter in the form of industrial wastes has often been tried with success as an anti-malarial measure. In a case reported from the Philippines bagasse from sugarcane mills seemed to be keeping a stream free from *flavirostris* ; the refuse from the Government Sisal Experiment Station is alleged to have a similar action, while the numerous large pits used for macerating *canepa* hemp in Italy do not breed anophelines. Stagnant pools, such as engineering borrow-pits into which green cut vegetation has been thrown, are stated to breed culicines only, anophelines being inhibited. The lethal effect of a fortnight-old brew of cut grass is said to be remarkable. The extention of this method in the form of ' herbage-packing ' to shallow, small-volume, running channels has been advocated by Williamson and the present authors. They think that the effect of this is not mechanical but biological, and consider that the use of green cut vegetation is very important, for dry straw will only result in a hay infusion favourable to larval growth. It is not every plant, however, that is suitable in the case of running water. According to these authors, ' The best so far found in India are *Cleistanthus* species and *Holorrhena antidysenterica* (sic). The first of these are fish poisons ; the latter contains several alkaloids.'

We are confident, however, that many more plants, mentioned in the synopsis at the end of this article would be found equally good or even better for this purpose, but the piscicidal plants in connexion with this must be employed with caution, since it is inadvisable to use them if the water contains fishes, or drains into tanks or reservoirs containing them.

There are also a number of plants which are utilized as insect repellents, e.g. roots of costus, *Saussurea lappa* C. B. Clarke, essential oil from *Eucalyptus globulus* Labill., leaves of *neem*, *Azadirachta indica* Juss., and of patchouli, *Pogostemon heyneanus* Benth., etc. The investigation of vegetable insecticides and insect repellents from among the vast potential resources existing in this country will repay scrutiny.

(*b*) *Plants poisonous to fish.*—That there are many plants in the Indian flora which have deleterious effect on fish is well known. Wholesale poisoning of fish in ponds, streams and pools by means of these plants is very uneconomical and is not allowed in any civilized country, but cases are known where such plants have come into contact with water and enormous numbers of fish have died as a result. This aspect of these plants, though not perhaps so important as the other, cannot be entirely left out of consideration in the study of poisonous plants. The list of plants growing in India having a poisonous action on fish is very long and a large number of them have been referred to in the book, *Indigenous Drugs of India* ; lately considerable additions have been made which may be of interest to those wanting further information. This group is of importance, as some of the insecticides are

also piscicides and *vice versa* and a systematic investigation of this group may lead to the discovery of effective insecticides, which is the crying need of this country at the present time.

We have briefly referred to the toxicological aspects of plants growing in India in a very general way. A good deal of work has been done in connexion with poisonous plants in Europe, America, South Africa and other countries, yet little or no systematic work has so far been attempted in India. The senior author was deeply impressed with this regrettable state of affairs when he took up work on Indian indigenous drugs nearly twenty years ago. Unfortunately it was not possible to start even a general survey of this group till a few years ago when the Imperial Council of Agricultural Research gave a grant and added a botanical section to the already-existing unit composed of chemists and pharmacologists paid by funds generously given by the Indian Research Fund Association twelve years ago. With this team of enthusiastic workers a beginning was made. To start with, three thousand circulars were sent out to the forest, veterinary, medical and agriculture departments of different provinces, to universities and to individual workers all over India. Different parts of the country were visited and first-hand information from all local sources by extensive investigations carried out in the field was obtained. All the existing herbaria were scrutinized, the information thus collected was analysed and a monograph on the subject of Poisonous Plants of India is now in the course of preparation. A list of nearly 700 plants reputed to be poisonous to man, livestock, insects, fish, etc., has been prepared which is by far the largest so far collected in this country. In the case of many plants, poisonous properties are suspected but have not been substantiated by chemical analysis and pharmacological experimentation. This is now being done so far as is possible with the resources at our disposal and preliminary chemical examinations of many important plants are being made. A thorough and comprehensive study of all these plants is the work of many years, perhaps of several generations. In the present work we are getting together all available information, botanical, chemical and pharmacological, in connexion with poisonous plants growing in India together with all references in the literature. The monograph, when completed, will serve as a basis for future work on these plants, the importance of which from an economic point of view cannot be overrated.

A conspectus of poisonous Phanerogams (including food poisons) growing in India, either in a state of nature or under cultivation, is appended. This will give some idea as to the ground covered in our recent investigations and the scope of the monograph, which will be profusely illustrated. The plants have been dealt with according to Bentham and Hooker's system of classification and the important active principles occurring in each family have been given and the main effects produced have been briefly discussed. Special attention has been paid to the nomenclature of plants and adherence to the International Rules has caused, unfortunately, several departures from the names used in *The Flora of British India*. A large number of plants, as described in that monumental work, are differently understood or are differently named or spelt by modern botanists. Some of these changes have now become well known in India. In this brief article, we have not attempted

to point out all departures from *The Flora of British India*, but have only indicated some of the less-established changes in this direction which were considered necessary.

We take the opportunity of expressing our gratitude to the Imperial Council of Agricultural Research for the generous grant to this inquiry and to all our colleagues of the indigenous drugs inquiry and of the Calcutta School of Tropical Medicine, the forest, agricultural, veterinary and medical departments of various provinces and Indian states, the Superintendent, Royal Botanic Gardens, Sibpur, the Botanical Survey of India, the chemical examiners, universities, and other individuals who have helped us in this important work, both in the field and in the laboratories and herbaria.

Families and active principles	Names of plants	General remarks
1. *Ranunculaceae* (Buttercup Family) Anemonin, aconitin, indaconitin, pseudaconitin, adonidin, delphinine, staphysagroine, cyanogenetic glucosides, essential oils, saponins, etc.	1. *Aconitum balfourii* Stapf, *A. chasmanthum* Stapf *ex* Holmes, *A. deinorrhizum* Stapf, *A. elwesii* Stapf, *A. falconeri* Stapf, *A. ferox* Wall, *ex* Seringe, *A. laciniatum* Stapf, *A. laeve* Royle, *A. lethale* Griff., *A. luridum* Hk. *f.* & T., *A. moschatum* Stapf, *A. soongaricum* Stapf, *A. spicatum* Stapf, *A. violaceum* Jacq.	Cardiac depressant and nerve poison; cause deaths among livestock; also used as arrow poison
	2. *Actaea spicata* Linn.	Acrid and poisonous; deaths among horses reported
	3. *Adonis aestivalis* Linn., *A. chrysocyathus* H. *f.* & T.	Poisonous to animals; heart poison
	4. *Anemone obtusiloba* D. Don.	Vesicant; taken internally produces vomiting and purging, drying alters properties
	5. *Aquilegia vulgaris* Linn.	Poisonous
	6. *Caltha palustris* Linn.	Acrid and poisonous; deaths among horses reported
	7. *Cimicifuga foetida* Linn.	Heart depressant; insect repellent
	8. *Clematis gouriana* Roxb., *C. graveolens* Lindl., *C. napaulensis* DC., *C. orientalis* Linn., *C. triloba* Heyne, *C. wightiana* Wall.	Blistering, properties altered by drying

	9. *Delphinium brunonianum* Royle, *D. caeruleum* Jacq., *D. elatum* Linn., *D. vestitum* Wall.	Cardiac and respiratory depressants; acrid taste, insecticidal, poisonous to animals
	10. *Nigella sativa* Linn.	Abortive in larger doses
	11. *Paeonia emodi* Wall.	Narcotic
	12. *Ranunculus arvensis* Linn., *R. falcatus* Linn., *R. laetus* Wall., *R. lingua* Linn., *R. pensylvanicus* Linn. *f.*, *R. sceleratus* Linn.	Vesicant and poisonous to livestock when fresh; drying alters properties
2. *Magnoliaceae* (Magnolia and Champa Family) Shikimin, illicin, essential oils	1. *Illicium griffithii* Hk. *f.* & T., *I. religiosum* Sieb. & Zucc.	Star anise of China (*I. verum* Hook. *f.*) imported into India sometimes adulterated with *I. religiosum*; has produced deaths. The latter is respiratory and cardiac poison. Indian *I. griffithii* also referred to as poisonous
3. *Annenaceae* (Custard apple Family) Resin, alkaloid, etc.	1. *Annona reticulata* Linn., *A. squamosa* Linn.	Seeds intensely irritant to conjunctiva; locally used as abortifacient, insecticidal; roots drastic purgative
4. *Menispermaceae* (Moonseed Family) Picrotoxin, saponins	1. *Anamirta cocculus* (Linn.) W. & A.	Convulsant poison; insecticide; used to poison fish and cattle
	2. *Pachygone ovata* (Poir.) Miers	Insecticide, piscicide
5. *Berberidaceae* (Barberry Family) Berberine, podophyllum resin	1. *Berberis aristata* DC. (and probably few more species)	Poisonous to lower animals; piscicide
	2. *Podophyllum hexandrum* Royle (= *P. emodi* Wall. *ex* Hk. *f.* et T.).	Drastic purgative, resin irritant to mucous membranes

Families and active principles	Names of plants	General remarks
6. *Papaveraceae* (Poppy Family)	1. *Argemone mexicana* Linn.	Oil occasionally mixed with mustard oil; adulterated mustard oil experimentally produced condition resembling epidemic dropsy
Morphine, codeine, protopine, thebaine, papaverine, narcotine, narceine, etc.	2. *Meconopsis aculeata* Royle, *M. napaulensis* DC.	Roots narcotic
	3. *Papaver dubium* Linn., *P. nudicaule* Linn., *P. rhoeas* Linn., *P. somniferum* Linn.	All species yield opium more or less, *P. somniferum* the chief source; opium used for suicidal purposes
7. *Cruciferae* (Mustard Family)		
Glucosides on contact with water produce vesicant essential oils	1. *Brassica cernua* (Thunb.) Forbes et Hemsl., *B. integrifolia* (West) O. E. Schulz, *B. juncea* (Linn.) Czernjaew et Cosson (*rai*); *B. napus* Linn. with four varieties (*toria, sarson*); *B. nigra* (Linn.) Koch (black mustard)	Vesicant; mustard cakes if fed in large amounts and over prolonged periods harmful to cattle, *sarson* cake safest, mixture with *rai* or black or white mustard dangerous
	2. *Lepidium draba* Linn.	Fish poison
	3. *Sinapis alba* Linn. (white mustard)	Discussed under *Brassica*
8. *Capparidaceae* (Caper Family)	1. *Capparis aphylla* Roth	Vesicant
Essential oils	2. *Cleome felina* Linn. *f.*, *C. viscosa* Linn.	Vesicant
	3. *Gynandropsis gynandra* (Linn.) Merr. (*G. pentaphylla* DC.).	Insecticide, piscicide, vesicant

9. *Bixaceae* **(Chaulmoogra Family)**		
Cyanogenetic glucoside; chaulmoogra oil	1. *Gynocardia odorata* R. Br.	Fruit piscicide
	2. *Hydnocarpus kurzii* (King) Warb. (=*Taraktogenos kurzii* King), *H. laurifolia* (Dennst.) Sleumer (=*H. wightiana* Bl.)	Fruit piscicide. Seed oil gastro-intestinal irritant
10. *Polygalaceae* **(Milkwort Family)**		
Saponins	1. *Polygala chinensis* Linn., *P. crotalarioides* Buch.—Ham., *P. telephioides* Willd.	Expectorant, emetic, acrid
11. *Caryophyllaceae* **(Carnation Family)**		
Saponins	1. *Saponaria vaccaria* Linn., and probably some others of the family	Acrid; toxicity partially removed by boiling
12. *Hypericaceae* **St. John's-wort Family** **Balsamic resinous juice**	1. *Hypericum perforatum* Linn.	Poisonous to animals, especially horses if taken in excess, usually however not eaten
13. *Guttiferae* **(Gamboge Family)**		
Gum resins	1. *Calophyllum inophyllum* Linn.	Fish poison
	2. *Garcinia morella* Desrouss and probably others	Gum resin violent gastro-intestinal irritant
14. *Ternstroemiaceae* **(Tea Family)**		
Caffeine, theophylline	1. *Thea sinensis* Linn.	Excessive indulgence harmful
15. *Malvaceae* **(Cotton Family)**		
Gossypol, resin, ephedrine, pseudo-ephedrine	1. *Gossypium* species	Root bark emmenagogue and used as abortifacient, occasional harmful effects of cotton seed cake on animals reported

Families and active principles	Names of plants	General remarks
15. *Malvaceae*—contd.		
	2. *Malva parviflora* Linn.	Narcotic effects on animals reported
	3. *Sida rhombifolia* Linn.	Ripe capsules reported fatal to fowls
16. *Linaceae* (Flax Family)		
Cyanogenetic compounds ; cocaine	1. *Erythroxylum coca* Lam.	Central nervous stimulant ; sensory nerve endings—paralysant ; addiction harmful
	2. *Linum usitatissimum* Linn.	Young plants produced deaths in animals ; sometimes seed cake also harmful
17. *Zygophyllaceae* (Bean-caper and Guaicum Family)		
Harmine, harmaline, harmalol, peganine, essential oils, saponins, resins	1. *Peganum harmala* Linn.	Insecticide, narcotic, nauseant and emetic. Used as abortifacient, protoplasmic poison ; paralyses skeletal and cardiac muscles of frogs
	2. *Tribulus terrestris* Linn.	Causes geeldikkop (dikgeel) in South Africa in small stock ; characterized by oedema of head, fever and jaundice
18. *Rutaceae* (Rue Family)		
Essential oils, rutin, skimmianine, saponins, resins, etc.	1. *Acronychia pedunculata* (Linn.) Miq. (=*A. laurifolia* Bl.)	Fish poison
	2. *Ruta graveolens* Linn. var. *angustifolia* Hk. *f.*, *R. tuberculata* Forsk.	Acro-narcotic poison, rubefacient : oil and herb frequently used to produce criminal abortion
	3. *Skimmia laureola* Sieb. & Zucc. *ex*-Walp.	Reported poisonous to sheep and goats

	4. *Zanthoxylum alatum* Roxb. (probably some more species)	Fish poison
19. *Simarubaceae* (Bitter-bark Family)		
Essential oils, saponins, resins, bitter substances	1. *Ailanthus altissima* (Mill.) Swingle (=*A. glandulosa* Desf.)	Nauseant, nervous system depressant, accumulation of its leaves in well water reported to produce chronic gastritis
	2. *Balanites roxburghii* Planch.	Fish poison, purgative
	3. *Brucea sumatrana* Roxb.	Seeds produce nausea, vomiting, abdominal pain and purging
	4. *Picrasma napalensis* Benn.	Stated to be used as larvicide in Sikkim
20. *Meliaceae* (Neem & mahogany Family)		
Bitter substances, bitter oil, saponins	1. *Azadirachta indica* A. Juss	Parasiticidal, leaves used as insect repellent
	2. *Melia azedarach* Linn.	Berries especially poisonous to man and animals; narcotic and gastro-intestinal irritant
	3. *Walsura piscidia* Roxb.	Dangerous emmenagogue, violent emetic, largely used as a fish poison
21. *Celastraceae* (Spindle-tree Family)		
Alkaloid, essential oil, resin	1. *Elaeodendron glaucum* Pers.	Emetic; overdoses fatal
22. *Sapindaceae* (Soap-nut Family)		
Saponins, cyanogenetic compounds	1. *Cardiospermum halicacabum* Linn.	Leaves emetic and rubefacient
	2. *Dodonaea viscosa* Linn.	Fish poison; deleterious to camels

Families and active principles	Names of plants	General remarks
22. *Sapindaceae*—contd.		
	3. *Harpullia cupanioides* Roxb.	Fish poison
	4. *Melianthus major* Linn.	Produces acute diarrhoea, salivation and colic ; honey from flowers stated to be poisonous
	5. *Sapindus mukorossi* Gaertn., *S. trifoliatus* Linn.	Fish poison, emetic, purgative ; used for procuring abortion
	6. *Schleichera oleosa* (Lour.) Merr. (=*S. trijuga* Willd.).	Oil occasionally mixed with mustard oil or ghee produces irritant poisoning ; seeds used as insecticide
23. *Anacardiaceae* (Cashew & mango Family)		
Toxic phenolic compounds, toxic resin	1. *Anacardium occidentale* Linn.	Pericarp contains powerfully vesicant juice, used to preserve floors, wood, books, etc. from white ants ; tar from bark also vesicant
	2. *Holigarna arnottiana* Hook. *f.*, *H. ferruginea* March, *H. grahamii* (wight) Hook. *f.*, *H. longifolia* Buch.-Ham. *ex* Roxb.	Juice vesicant although not equally powerful in all species
	3. *Rhus insignis* Hook. *f.*, *R. punjabensis* J. L. Stewart, *R. succedanea* Linn., *R. wallichii* Hook. *f.*	Dreaded by local people ; even smoke from burning wood dreaded ; juice vesicant
	4. *Semecarpus anacardium* Linn. *f.*, *S. travancoricus* Bedd.	Pericarp contains vesicant juice. Sometimes used locally as abortifacient
24. *Coriariaceae* (Coriaria Family)		
Coriamyrtin, tutin in foreign species	1. *Coriaria nepalensis* Wall.	Stated to be narcotic ; foreign species very poisonous acting like picrotoxin and producing convulsions

25. *Moringaceae* (Horse-radish Family) **Essential oils, alkaloid, moringine, moringinine**	1. *Moringa oleifera* Lamk. (=*M. pterygosperma* Gaertn)	Fresh root bark vesicant, used to procure abortion. Moringinine acts on the sympathetic nervous system
26. *Leguminosae* (Pea Family) **Alkaloids ; glucosides, saponins, cyanogenetic compounds, rotenone, toxic albumin, bitter substances, globulins**	1. *Abrus precatorius* Linn.	Specially blood poison, used to poison cattle and to procure abortion
	2. *Acacia pennata* Willd.	Fish poison
	3. *Albizzia procera* Benth.	Fish poison
	4. *Butea monosperma* (Lam.) O. Ktze. (=*B. frondosa* Koen. *ex*-Roxb.)	Seeds insecticide ; painful if taken internally
	5. *Caesalpinia nuga* Ait	Fish poison
	6. *Canavalia virosa* W. & A. (*C. ensiformis* DC. var. *Virosa* Baker)	Fruit stated to be poisonous
	7. *Cassia absus* Linn., *C. acutifolia* Delile, *C. alata* Linn., *C. angustifolia* Vahl, *C. fistula* Linn., *C. obovata* Collad	Purgative ; irritant in large doses, *C. absus* seeds dangerous application to eyes. *C. alata* fish poison
	8. *Clitoria ternatea* Linn.	Roots powerful cathartic like Jalap ; not a safe medicine
	9. *Cytisus scoparius* Link.	Plants not eaten by cattle ; emetic and cathartic
	10. *Dalbergia stipulacea* Roxb.	Fish poison
	11. *Derris elliptica* Benth., *D. scandens* Benth., *D. uliginosa* Benth., (Possibly *D. ferruginea* Benth.)	Fish poison. *D. elliptica* is insecticidal

Families and active principles	Names of plants	General remarks
26. *Leguminosae*—contd.	12. *Entada phaseoloides* (Linn.) Merr. (=*E. scandens* Benth.)	Fish poison
	13. *Lathyrus aphaca* Linn., *L. sativus* Linn.	Food and fodder. *L. sativus* if taken in larger amounts and over prolonged period produces lathyrism in men and animals. Ripe seeds of *L. aphaca* stated to be narcotic in excess
	14. *Melilotus alba* Desr.	Stated to be poisonous to cattle
	15. *Milletia auriculata* Baker, *M. pachycarpa* Benth., *M. piscidia* Wight	Fish poison; *M. auriculata* is an insecticide
	16. *Mundulea suberosa* Benth	Fish poison
	17. *Ougenia dalbergioides* Benth	Fish poison
	18. *Phaseolus lunatus* Linn.	Coloured variety sometimes exhibits poisonous properties if eaten
	19. *Pithecellobium bigeminum* Mart.	Fish poison. Seeds stated to be eaten in Burma but sometimes produce disastrous results
	20. *Pongamia pinnata* (Linn.) Merr. (=*P. glabra* Vent.)	Piscicide and insecticide
	21. *Sophora mollis* R. Grah., and Var. *hydaspidis* Baker, *S. tomentosa* Linn.	Seeds of *S. mollis* insecticidal, leaves of *S. tomentosa* powerfully emetic and cathartic in large doses

	22. *Tephrosia candida* Linn., *T. purpurea* Pers. (F. B. I. in part)	Fish poison. Some foreign species are insecticides. Species of *Tephrosia* in India likely to prove of value as insecticides
	23. *Trifolium repens* Linn.	Highly prized fodder in Europe. Very suspicious in Himalayas where poisoning reported in horses
	24. *Vicia sativa* Linn.	Suspected to cause lathyrism—see *Lathyrus sativa*
27. *Rosaceae* (Rose Family)		
Cyanogenetic glucosides, phloridzin	1. *Prunus amygdalus* Batsch. (bitter variety), *P. armeniaca* Linn., (bitter variety), *P. avium* Linn., *P. cerasus* Linn., *P. mahaleb* Linn., *P. padus* Linn., *P. persica* Stokes., *P. puddum* Roxb., *P. undulata* Buch.—Ham.	Seeds poisonous, leaves of many said to be dangerous to livestock when wilted ; harmless when on the plant, suspicious when dried
	2. *Pygeum gardneri* Hook. *f.*	Seeds fish poison
	3. *Pyrus aucuparia* Linn., *P. malus* Linn.	Bark of *P. aucuparia* irritant to the alimentary tract ; wilting leaves of other occasionally poisonous to animals browsing upon them
	4. *Rubus moluccanous* Gaertn.	Leaves reported as powerful emmenagogue and abortifacient
28. *Crassulaceae* (Life-plant Family)		
Glucosides—in foreign species	1. *Kalanchoe spathulata* DC.	Expressed juice of bitter variety drastic purgative ; poisonous to goats, not eaten by cattle ; leaves said to be insecticide
29. *Droseraceae* (Sundew Family)		
	1. *Drosera peltata* Sm. var. *lunata* Clarke, *D. spathulata* Labill. (*D. burmanni* Vahl)	Rubefacient. Some Australian species reported injurious to sheep

Families and active principles	Names of plants	General remarks
30. *Combretaceae* (Myrobolan Family) **Tannins**	1. *Terminalia bellerica* Roxb., *T. chebula* Retz.	*T. bellerica* reported fish poison ; kernel stated to be poisonous and cases reported where narcotism followed nausea and vomiting, evidence however conflicting. Some varieties of *T. chebula* drastic purgative
31. *Myrtaceae* (Myrtle and *jamun* Family) **Saponins, essential oils, tannins**	1. *Barringtonia acutangula* Gaertn., *B. asiatica* Kurz. (=*B. speciosa* Forst.), *B. racemosa* Bl.	Fish poisons
	2. *Careya arborea* Roxb.	Fish poison, inner bark rubbed on shoes keeps off leeches
	3. *Eucalyptus globulus* Labill.	Essential oil an important ingredient of insecticides ; internally gastro-intestinal irritant
	4. *Melaleuca leucadendron* Linn.	Essential oil is an irritant and a mosquito repellent
32. *Lythraceae* (Henna and pomegranate Family) **Acrid principle**	1. *Ammania baccifera* Linn., *A. senegalensis* Lamk.	Acrid, vesicant ; internally cause great pain
	2. *Lagerstroemia indica* Linn., *L. speciosa* (Linn.) Pers. (=*L. flos-regineae* Retz.)	Bark and leaves purgative ; seeds of former narcotic
33. *Samydaceae* (Cascaria Family)	1. *Cascaria graveolens* Dalz., *C. tomentosa* Roxb.	Pounded fruit used as a fish poison

34. *Caricaceae* **(Papaw Family)** Carpaine, carposide, caricin in seeds yielding essential oil on hydrolysis ; papain	1. *Carica papaya* Linn	Seeds believed to be powerfully emmenagogue and used as abortifacient. The juice of unripe fruit acrid or even vesicant
35. *Passifloraceae* **(Passion-flower Family)** Hydrocyanic acid, saponins	1. *Adenia (Modecca) palmata* Engl., *A. wightiana* Engl.	Roots and fruits poisonous. Deaths from fruits of *A. palmata* reported
36. *Cucurbitaceae* **(Cucumber Family)** Bitter substances, such as colocynthin, alkaloids, glucosides, saponins	1. *Citrullus colocynthis* Schrad, *C. vulgaris* Schrad (bitter variety)	Fruit purgative ; *C. colocynthis* a drastic purgative has produced fatal results, dust when dry very irritating to eyes and nostrils
	2. *Corallocarpus epigaeus* Benth. & Hook. *f.*	Fruit drastic purgative
	3. *Cucumis sativus* Linn. (bitter variety), *C. trigonus* Roxb.	Fruit purgative, *C. trigonus* excessively so
	4. *Lagenaria vulgaris* Seringe (Wild variety)	Drastic purgative, case reported where beer kept in bottle gourd produced poisoning
	5. *Luffa acutangula* Roxb. var. *amara* C. B. Clarke, *L. aegyptiaca* Mill. *ex*-Hook. *f.* (wild variety), *L. echinata* Roxb.	Fruit of *L. acutangula* var. *amara* violently emetic and purgative, is not eaten ; others also purgative
	6. *Momordica balsamina* Linn., *M. charantia* Linn., *M. tuberosa* Cogn. (=*M. cymbalaria* Fenzl)	Fruit of *M. balsamina* fatal to dogs. Death from violent vomiting and purging from juice of plant. *M. charantia*, roots used as abortifacient. Decoction of roots of *M. tuberosa* used as abortifacient

Families and active principles	Names of plants	General remarks
36. *Cucurbitaceae*—contd.	7. *Trichosanthes bracteata* Voigt (=*T. palmata* Roxb.), *T. cucumerina* Linn., *T. dioica* Roxb.	Root powerful cathartic. Fruit of *T. cucumeriana* never eaten, because of powerful cathartic action. Fruit of *T. bracteata* used as cattle poison and to destroy crows
	8. *Zanonia indica* Linn.	Fruit very acrid and cathartic
37. *Begoniaceae* (Begonia Family)	1. *Begonia rex* Putzeys	Juice poisonous to leeches
38. *Ficoideae*	1. *Trianthema portulacastrum* Linn. (*T. monogyna* Linn.), *T. pentandra* Linn.	Roots irritant and cathartic. Leaves and stems used as pot herb but occasionally said to produce paralysis and diarrhoea
39. *Umbelliferae* (Carrot and coriander Family)	1. *Apium graveolens* Linn.	Seeds irritant, poison in overdoses
Essentia oils, cicutoxin, cicutoxinin, vellerin	2. *Centella asiatica* (Linn.) Urb. (= *Hydrocotyle asciatica* Linn.).	Stupefying narcotic in larger doses; a cumulative poison
	3. *Cicuta virosa* Linn.	Cause of extensive poisoning in Europe, the active principle belongs to picrotoxin in group of poisons which are convulsant
	4. *Daucus carota* Linn.	Seeds used for procuring abortion, tuberous roots eaten
	5. *Hydrocotyle javanica* Thunb.	Stated to be a fish poison

40. *Araliaceae* **(Ivy and Panax Family)**		
Resin, α—hederin saponin	1. *Hedera helix* Linn.	Decoction of leaves used to kill lice; other poisonous properties also assigned
41. *Caprifoliaceae* **(Honey-suckle Family)**		
Sambucine, cyanogenetic glucoside, sambunigrin, bitter substances, resin (cathartic)	1. *Sambucus ebulus* Linn., *S. nigra* Linn.	Strongly purgative. *S. ebulus* has foetid smell when bruised, is not eaten by cattle; poisoning amongst boys and fowls reported
42. *Rubiaceae* **(Madder and coffee Family)**	1. *Adina cordifolia* Benth. & Hook. *f.*	Juice used as insecticide
Quinine, quinidine, cinchonine, cinchonidine, caffeine, emetine, cephaeline, ipecacuanhin, essential oils, saponins	2. *Cinchona calisaya* Wedd. and var. *ledgeriana* Howard, *C. officinalis* Linn. *f.*, *C. succirubra* Pavon.	Source of cinchona alkaloids, general protoplasmic poison and parasiticide; plants fish poisons
	3. *Coffea arabica* Linn.	Excessive indulgence harmful, chronic poisoning
	4. *Psychotria ipecacuanha* Stokes	Emetic and irritant and cardiac depressant
	5. *Randia dumetorun* Lamk., *R. uliginosa* DC.	Fish poisons; *R. dumetorum* used to preserve grain from attacks of insects, used as abortifacient
43. *Compositae* **(Sun-flower Family)**		
Essential oils, artemisin, santonin, bitter substances (absinthin, lactucin, etc.), saponins, resin, senecio, alkaloids, xanthostrumarin, pyrethrins	1. *Anthemis cotula* Linn.	Undesirable food for livestock; acrid and vesicant
	2. *Artemisia absinthium* Linn., *A. maritima* Linn., *A. vulgaris* Linn.	Essential oil from *A. absinthium* violent narcotic poison producing convulsions; *A. maritima* irritant poison in large doses, fatal cases reported; *A. vulgaris* produces epileptiform spasms, also reported fish poison

Families and active principles	Names of plants	General remarks
43. *Compositae*—contd.	**3.** *Centhratherum anthelminticum* O. Ktze (=*Vernonia anthelmintica* Willd.)	Used as insecticide and insect repellent
	4. *Chrysanthemum cinerariifolium* Vis. *C. coccineum* Willd. (*C. roseum* Adam.)	Reputed insecticides
	5. *Erigeron canadensis* Linn.	Irritant
	6. *Eupatorium odoratum* Linn.	Stated fish poison ; *U. urticifolium* L. *f.* of foreign countries produces acidosis and trembles in sheep and cattle
	7. *Gnaphalium luteo-album* Linn.	Suspected of causing livestock-poisoning in South Africa
	8. *Inula graveolens* Desf.	Suspected poisonous to livestock
	9. *Lactuca tatarica* C. A. Meyer, var. *tibetica* C. B. Clarke	Occasionally browsed by sheep ; sometimes injurious
	10. *Saussurea lappa* C. B. Clarke	Roots used against insects
	11. *Senecio* species (*S. vulgaris* Linn. introduced plant)	Important genus, worth study in India ; ragwort poisoning due to several species well known in foreign countries ; various species produce hepatic cirrhosis
	12. *Sphaeranthus indicus* Linn.	Fish poison
	13. *Xanthium strumarium* Linn.	Reported poisonous to cattle and pigs in America and Australia

44. *Campanulaceae* (Bell-flower Family) Alkaloids	1. *Lobelia excelsa* Leschen., *L. nicotianifolia* Heyne	Irritants to nose, death reported in man, action like nicotine, except more burning pain in the stomach, used as substitute for *datura*
45. *Ericaceae* (Rhododendron Family) Andromedotoxin, ericolin, essential oils	1. *Gaultheria fragrantissima* Wall.	Irritant poison ; deaths reported from use as abortifacient
	2. *Pieris ovalifolia* D. Don.	Poisonous to goats ; insecticide
	3. *Rhododendron anthopogon* D. Don., *R. arboreum* Sm., *R. barbatum* Wall., *R. campanulatum* D. Don., *R. cinnabarinum* Hook. *f.*, *R. falconeri* Hook. *f.*, *R. setosum* D. Don.	Probably all poisonous to stock ; some reported fish poisons ; honey from some reported poisonous
46. *Plumbaginaceae*— (Plumbago Family) Plumbagin	1. *Plumbago indica* Linn. (=*P. zeylanica* Linn.,) *P. rosea* Linn.	Strong irritant externally and internally ; used to procure abortion
47. *Primulaceae*— (Prim-rose Family) Saponins	1. *Anagallis arvensis* Linn.	Produces gastro-enteritis in dogs and horses ; used to poison fish and expel leeches from nostrils of animals
	2. *Cyclamen persicum* Miller	Fish poison
	3. *Primula reticulata* Wall.	Stated to be poisonous to cattle
48. *Myrsinaceae*— (Ardisia Family) Saponins	1. *Maesa indica* Wall.	Leaves stated as fish poison
49. *Sapotaceae*— (Sapodilla and mohwa Family) Saponins	1. *Madhuca* (*Bassia*) *latifolia* (Roxb.) Macbride, *M. longifolia* (Linn.) Macbride	Residual cake used as fish poison ; said to be insecticide and used to kill worms on lawns (*mohwa* meal)
50. *Ebenaceae*— (Ebony Family)	1. *Diospyros ebenum* Koenig, *D. montana* Roxb., *D. paniculata* Dalz	Fish poisons

Families and active principles	Names of plants	General remarks
51. *Salvadoraceae*— (Salvadora Family)	1. *Salvadora oleoides* Dcne., *S. persica* Linn.	Root bark vesicant
52. *Apocynaceae*— (Dog-bane and Oleander Family) 'dita' 'kurchi' and rauwolfia alkaloids; glucosides, e.g. cerberin, karabin, neriin, neriodorein, neriodorin, oleandrin, 1-strophanthin, thevetin etc.; bitter substances	1. *Allamanda cathartica* Linn.	Hydragogue cathartic
	2. *Cerbera manghas* Linn. (=*C. odollam* Gaertn.)	Green fruit used to poison dogs; seeds irritant poison; plant fish poison
	3. *Ervatamia dichotoma* (Roxb.) Blatter (= *Tabernaemontana dichotoma* Roxb.)	Seeds powerfully narcotic and poisonous
	4. *Holarrhena antidysentrica* Wall.	Not browsed by cattle and goats; anthelmintic; kurchicine general protoplasmic poison.
	5. *Lochnera pusilla* K. Schum (=*Vinca pusilla* Murr., *L. rosea* (Linn.), Reichb. (=*Vinca rosea* Linn.)	Cardiac poisons; *L. pusilla* regarded as poisonous to cattle
	6. *Melodinus monogynous* Roxb.	Fish poison
	7. *Nerium indicum* Mill (=*N. odorum* Soland)	Very poisonous. Used for suicidal purposes and to procure abortion; depresses nervous system and heart
	8. *Plumeria acuminata* Ait. (=*P. acutifolia* Poir.)	Milk rubefacient, used to procure abortion; internally purgative. Poisonous
	9. *Rauwolfia serpentina* Benth. ex Kurz	Hypnotic, fish poison
	10. *Thevetia peruviana* (Pers.) Merr. (=*T. neriifolia* Juss.)	All parts especially seeds very poisonous. Used to poison cattle; produces violent vomitting and purging. Action on heart like digitalis. Fish poison

53. *Asclepiadaceae*— (Milk-weed Family)	1. *Asclepias curassavica* Linn.	Fish poison, emetic, cathartic
	2. *Calotropis gigantea* R. Br., *C. procera* R. Br.	Milk drastic purgative, caustic ; stated to be used for suicidal and homicidal purposes and as an abortifacient and cattle poison
	3. *Cryptostegia grandiflora* R. Br.	Fatal case due to leaves reported in which persistent vomiting observed.
	4. *Cynanchum arnottianum* Wight, *C. vincetoxicum* Pers.	*C. arnottianum* used as insecticide, *C. vincetoxicum* not eaten by cattle and regarded poisonous ; root emetic.
	5. *Sarcostemona acidum* (Roxb.) Voigt (=*S. brevistigma* W. & A.)	Stated to have insecticidal properties.
	6. *Secamone emetica* R. Br.	Root acrid ; plant powerfully emetic.
	7. *Tylophora indica* (Burm. *f.*) Merr. (=*T. asthmatica* Wight and Arn.), *T. fasiculata* Buch.—Ham.	Fatal cases reported in man ; emetic ; *T. fasciculata* used as rat poison
54. *Loganiaceae*— (Nux-vomica Family) strychnine, brucine, etc.	1. *Strychnos colubrina* Linn., *S. nux-vomica* Linn.	Poisonous. *S. nux-vomica* seeds used as fish poison and source of strychnine, one of the deadliest poisons known, suicidal and homicidal cases recorded, employed to kill dogs ; rodents, etc.
55. *Boraginaceae*— (Borage and Sebestan Family) Alkaloids	1. *Heliotropium eichwaldii* Steud., *H. indicum* Linn.	Suspected to be poisonous
56. *Convolvulaceae*— (Convolvulus Family) Convolvulin, pharbitin, terpithin, terpethein, cucutalin, resin	1. *Calonyction muricatum* (Linn.) G. Don. (=*Ipomoea muricata* Jacq.)	See *Ipomoea*
	2. *Convolvulus arvensis* Linn., *C. scammonia* Linn.	Roots strongly purgative
	3. *Cuscuta reflexa* Roxb.	Nauseant and emetic ; used to procure abortion
	4. *Ipomoea reptans* (Linn.) Poir. (=*I. aquatica* Forsk.), *I. nil* Roth (=*I. hederacea* Jacq.), *I. purga* Heyne.	Strongly purgative ; irritant poisons in overdoses
	5. *Operculina turpethum* (Linn.) Manso (=*Ipomoea turpethum* R. Br.)	See *Ipomoea*

Families and active principles	Names of plants	General remarks
57. *Solanaceae*— (Datura and nightshade Family)	1. *Atropa belladonna* Linn.	Fatal cases of poisoning reported; dryness of mouth and throat, dilation of pupils and delirium characteristic features
	2. *Capsicum annuum* Linn., *C. frutescens* Linn., *C. minimum* Roxb.	Seeds gastro-intestinal irritant; used for torturing
	3. *Datura fastuosa* Linn., *D. metel* Linn., *D. stramonium* Linn.	Commonly used by criminals for stupefying their victims, symptoms resemble those of atropa
	4. *Hyoscyamus muticus* Linn., *H. niger* Linn., *H. pusillus* Linn., *H. reticulatus* Linn.	Cases of livestock and children poisoning on record; action like atropa
	5. *Lycium barbarum* Linn.	Reported poisonous to livestock
	6. *Mandragora caulescens* Clarke	Suspected to be poisonous
	7. *Nicandra physaloides* Gaertn.	Insecticide
	8. *Nicotiana rustica* Linn., *N. tabacum* Linn.	Insecticide, also used to ward off leeches; fatal cases reported among human beings and stock
	9. *Physochlaina praealta* Miers.	Reported poisonous
	10. *Scopolia anomala* (Link et Otto) Airy-Shaw, (*S. lurida* Dunal.)	Poisonous, action like atropa
	11. *Solanum dulcamara* Linn., *S. incanum* Linn. (=*S. coagulans* Forsk) *S. nigrum* Linn. (unripe berries), *S. spirale* Roxb., *S. tuberosum* Linn. (sprouting).	Cases of poisoning among human beings and animals reported, some fatal: gastro-intestonal irritant; occasionally associated with atropa-like symptoms
	12. *Withania somnifera* Dunal	Reported to be used as abortifacient and as an insecticide, stated to be hypnotic

58. *Scrophulariaceae*— (Mimulus and Digitalis Family) Digitalin, digitonin, digitoxin, gitalin, gitonin, etc., saponin, bitter substance	1. *Digitalis purpurea* Linn.	Cardiac poison ; fatal case due to eating of plant reported in India
	2. *Verbascum thapsus* Linn.	Fish poison, seeds narcotic
59. *Bignoniaceae*— (Bignonia Family)	1. *Dolichandrone falcata* Seem.	Fish poisons reputed to be abortifacient
60. *Pedaliaceae*— (Sesamum Family) Sesamol (a phenolic substance), seasamolin	1. *Sesamum orientale* Linn. (=*S. indicum* Linn.)	Seed cakes commonly fed to cattle in India ; stated to be toxic to livestock in Europe producing colic, tremors, dyspnoea and distention
61. *Verbenaceae*— (Verbena and teak Family)	1. *Callicarpa longifolia* Lamk. var. *lanceolaria* C. B. Clarke	Fish poison
	2. *Duranta plumieri* Jacq.	Very bitter and believed to be poisonous to livestock, but generally refused
	3. *Lantana aculeata* Linn. (=*L. camara* Linn.)	Reports about being poisonous to livestock received from the Punjab and Assam Government Departments Stated to be abortifacient
	4. *Stachytarpheta jamaicensis* (Linn.), Vahl, var. *indica* H. J. Lam (=*S. indica* Vahl.)	
	5. *Verbena officinalis* Linn.	Stated to be irritant poison
62. *Labiateae*— (Mint and sage Family) Essential oils, saponins	1. *Eremostachys acanthocalyx* Boiss, *E. vicaryi* Benth.	E. *acanthocalyx* stated to be poisonous ; E. *vicaryi* used as a fish poison
	2. *Lamium amplexicaule* Linn.	Regarded as injurious in America
	3. *Pogostemon heyneanus* Benth. (*P. patchouli* F. B. I., non Pelletier)	Leaves used against insects
63. *Chenopodiaceae*— (Spinach and beet Family) Essential oils, saponins, salsoline, oxalic acid	1. *Chenopodium ambrosioides* Linn., *C. botrys* Linn.	Anthelmintic against hook worm and round worm. Fatal poisoning on record
	2. *Haloxylon recurvum* Bunge ex Boiss., *H. salicornicum* Bunge ex Boiss.	Stated to be poisonous but *H. recurvum* is a favourite food of camels

Families and active principles	Names of plants	General remarks
63. *Chenopodiaceae*—contd.	**3.** *Salicornia brachiata* Roxb.	Ash stated to be abortifacient
	4. *Salsola kali* Linn.	Suspected poisonous but a feeding test with half dried plants in flowering stage negative
	5. *Suaeda fruticosa* Forsk.	Stated to be poisonous
64. *Phytolaccaceae*— (Phytolacca Family) Bitter substances	**1.** *Phytolacca latbenia* (Buch-Ham.) H. Walt. (=*P. acinosa* Hook. *f.*, F. B. I., non-Roxb.	Stated poisonous if eaten raw, but it is edible when cooked
65. *Polygonaceae*— (Buck-wheat and rhubarb Family) Rutin, essential oils, anthra-quinone derivatives, oxalic acid, oxalates	**1.** *Fagopyrum esculentum* Moench, *F. tataricum* Gaertn.	Commonly eaten but under certain conditions, not properly understood at present, produces eruptions and urticaria
	2. *Polygonum aviculare* Linn., *P. flaccidum* Meissn), *P. hydropiper* Linn., *P. orientale* Linn., *P. persicaria* Linn., *P. tomentosum* Willd.	*P. hydropiper* biting to a degree that no animal will eat it. Acrid, emetic, vesicant, insecticidal and piscicidal properties to varying degree strongly suspected
	3. *Rheum emodi* Wall., and "probably some others	Petiole edible and so also the leaves, but latter responsible for occasional poisoning
	4. *Rumex acerosa* Linn., *R. acetosalla* Linn.	Oxalic acid poisoning if eaten in excess
66. *Aristolochiaceae*— (Birth-wort Family) Aristolochin, glucoside, essential oils, bitter substance	**1.** *Aristolochia bracteata* Retz., *A. indica* Linn.	Nauseous and bitter, emmenagogue and abortifacient ; *A. bracteata* insecticide
67. *Piperaceae*— (Pepper Family) Essential oils, piperine, piperovatine	**1.** *Piper* sp.	Harmful effects of *P. betle* Linn., *P. nigrum* Linn. well known

68. *Myristicaceae*— (Nutmeg Family) Essential oil (with myristicin), saponins	1. *Myristica fragrans* Houtt., *M. malabarica* Lamk., possibly some others also.	Narcotic ; occasional cases of poisoning reported
69. *Lauraceae*— (Laurel Family) Essential oils	1. *Cassytha filiformis* Linn. 2. *Cinnamomum camphora* F. Nees (product imported)	Stated to be used as insecticide Protective against moths ; counter-irritant, systemically stimulates then depresses and paralyses central nervous system
70. *Thymeliaceae*— (Mezereum Family) Saponins	1. *Daphne cannabina* Wall., *D. oleoides* Schreb. 2. *Edgeworthia gardneri* Meissn. 3. *Lasiosiphon eriocephalus* Dcne. 4. *Wikstroemia viridiflora* Meissn. (*W. indica* C. A. Mey, var. *viridiflora* Hook. *f.*)	Severe gastro-intestinal irritant, camels do not eat *D. oleoides* Fish poison Dust from dried plant very irritant, not eaten by livestock, fish poison Fish poison
71. *Loranthaceae*— (Mistletoe Family)	1. *Viscum* sp. and possibly others	Poisonous properties probably acquired if growing on poisonous hosts, e.g. *Strychnos nux-vomica*
72. *Euphorbiaceae*— (Croton and castor oil Family) Cyanogenetic compounds, saponins, crotonoside, ricinine, essential oils, euphorbon, phenolic substance, resins, toxalbumins	1. *Andrachne cordifolia* Muell.-Arg. 2. *Baliospermum montanum* Muell., Arg. (=*B. axillare* Blume.) 3. *Buxus sempervirens* Linn. 4. *Chrozophora rottleri* A. Juss ex Spreng. (=*C. tinctoria* Hook. *f.* in part) 5. *Cleistanthus collinus* Benth. & Hook. *f.* 6. *Croton oblongifolius* Roxb., *C. tiglium* Linn.	Cattle poisoning reported, African species used as insecticide Seeds and oil drastic purgative, seeds in overdoses acro-narcotic poison Stated to be fatal to camels and cattle ; goats probably immune Emetic and cathartic ; animals avoid it Used as fish poison and occasionally as human poison, extract violent gastro-intestinal irritant Seeds especially and the oil also drastic purgative ; poisoning reported ; seeds stated to be used as insecticide and piscicide

Families and active principles	Names of plants	General remarks
72. *Euphorbiaceae*—contd.	7. *Euphorbia acaulis* Roxb., *E. antiquorum* Linn., *E. cattimandoo* W. Elliot, *E. helioscopia* Linn., *E. hirta* Linn., *E. hypericifolia*, *E. neriifolia* Linn., *E. nivulea* Buch.-Ham., *E. peplus* Linn., *E. pilosa* Linn., *E. rothiana* Spreng., *E. royleana* Boiss., *E. thomsoniana* Boiss., *E. thymifolia* Linn., *E. tirucalli* Linn., *E. trigona* Haw	Acrid and vesicant juice in most species ; some used as abortifacient when applied locally ; *E. antiquorum*, *E. neriifolia*, *E. royleana*, *E. tirucalli*, fish poisons ; *E. antiquorum* and *E. thymifolia* stated to be used as insecticides, some poisonous to livestock
	8. *Excoecaria agallocha* Linn.	Fresh sap extremely acrid, causes intolerable pain if it gets into eye ; woodcutters have suffered, called blinding tree ; fish poison
	9. *Fluggea leucopyrus* Willd., *F. virosa* Baill (=*F. microcarpa* Bl.)	Fish poison, used to destroy worms in sores
	10. *Hura crepitans* Linn.	Seeds and oil violent purgative ; milky juice very irritant
	11. *Jatropha curcas* Linn., *J. glandulifera* Roxb., *J. gossypiifolia* Linn., *J. multifida* Linn.	Violent purgative like *croton* sp., *J. curcas* fish poison
	12. *Manihot utilissima* Pohl.	Fresh tubers extremely poisonous, cassava or tapioca meal specially prepared
	13. *Phyllanthus urinaria* Linn.	Stated to be fish poison
	14. *Ricinus communis* Linn.	Seeds produce violent gastro-enteritis, subcutaneously very poisonous. Oil stated to be an active poison for flies. Plant fish poison
	15. *Sapium indicun* Willd., *S. insigne* Trimen.	*S. indicun* juice narcotic poison ; fruit extremely nauseous, seeds fish poison. *S. insigne* juice vesicant

	16. *Tragia bicolor* Miq., *T. involucrata* Linn. (with varieties)	Stinging nettles
73. *Urticaceae*— (Nettle, hemp and mulberry Family) α-β&γ-antiarin, saponin, resin containing cannabindol (toxic), formic acid	1. *Antiaris toxicaria* Lesch.	Sap used as an arrow poison ; powerful heart poison
	2. *Cannabis sativa* Linn.	The preparations *bhang*, *charas*, and *ganja* well known in India ; excessive indulgence, injurious physically and mentally. Plant stated to be used as a fish poison in Bengal ; spread on beds to drive away bugs
	3. *Ficus* sp.	Some species contain acrid juice ; Watt states fruits of *F. bengalensis* poisonous to horses
	4. *Fleurya interrupta* Gaud	Stings
	5. *Girardinia leschenaultiana* Dcne., *G. zeylanica* Dcne	Stinging nettle
	6. *Laportea crenulata* Gaud., *L. terminalis* Wight	Stinging nettle
	7. *Urtica dioica* Linn., *U. hyperborea* Jacq., *U. parviflora* Roxb., *U. pilulifera* Linn.	Stinging nettle
74. *Juglandaceae*— (Walnut Family)	1. *Juglans regia* Linn.	Rind of unripe fruit stated to be used as fish poison in Jaunsar and Tehri Garhwal
75. *Myricaceae*— (Sweet-gale Family) Essential oils, myricelin	1. *Myrica nagi* Thunb.	Bark stated to be used as fish poison in Khasia hills
76. *Gnetaceae*— (Gnetum Family) Saponins, bitter substance	1. *Gnetum scandens* Roxb.	Fish poison

Families and active principles	Names of plants	General remarks
77. *Coniferea*— (Pine Family) Essential oils, taxine, taxicatin	1. Several members, especially *Taxus baccata* Linn.	Most members possess toxic essential oil and poisoning due to the use of *Juniper oil* as abortifacient reported. Deaths in man and animals due to eating the berries and leaves of *T. baccata* reported ; seeds very poisonous ; fish poison
78. *Iridaceae*— (Iris Family) Saponins, picrocrin (bitter substance) ; essential oils	1. *Crocus sativus* Linn.	Bulbs toxic to young animals ; stigmas in overdoses narcotic poison ; used as abortifacient
79. *Amaryllidaceae*— (Amaryllis and agave Family) Saponin, Lycorine, tazettine	1. *Agave americana* Linn.	Stated as fish poison, also stated toxic to livestock under field conditions, wall paper impregnated with expressed juice said to be proof against white-ants
	2. *Crinum asiaticum* Linn., *C. latifolium* Linn.	Bulbs of *C. asiaticum* strongly emetic and nauseant, those of *C. latifolium* extremely acrid and used for blistering cattle
	3. *Narcissus tazette* Linn.	Bulbous roots emetic and purgative, irritant poison in overdoses
80. *Taccaceae*—	1. *Tacca pinnatifida* Forst.	Tuber intensely bitter, acrid and poisonous when fresh, yields nutritious starch by maceration and repeated washing
81. *Bromeliaceae*— (Pine-apple Family)	1. *Ananas sativus* Schult.	Juice of leaves and unripe fruit purgative and sometimes used as abortifacient

82. *Dioscoreaceae*— (Yam Family) Dioscorine, glucoside (toxic)	1. *Dioscorea bulbifera* Linn., *D. hispida* Dennst. (=*D. daemona* Roxb.), *D. prazeri* Prain & Burk. (=*D. deltoidea* Wall.)	Tubers are very acrid but in most cases boiling, etc. makes them edible.
83. *Liliaceae*— (Lily Family) Imperialine, colchicine, methyl-colchicine, saponine, barbaloin, emodin, sicaloin, resin, essential oils, etc.	1. *Allium sativum* Linn.	Essential oil very irritant and pungent, produces irritant poisoning in excess, also stimulant narcotic, anthelmintic
	2. *Aloe* species	Insipissated juice 'Mushabbar' of commerce powerful drastic purgative; fatal cases reported; used to procure abortion
	3. *Colchicum luteum* Baker	Resembles closely the foreign *C. autumnale* which is poisonous and produces gastro-intestinal irritation; Indian also probably poisonous
	4. *Fritillaria imperialis* Linn.	Bulbs toxic when fresh, said to be a heart poison
	5. *Gloriosa superba* Linn.	Roots stated to be sometimes used for suicidal purposes and as abortifacient, acro-narcotic poison; juice of leaves stated to be used to destroy lice in the hair
	6. *Scilla indica* Baker 7. *Urginia coromandeliana* Hook. *f.*, *U. indica* Kunth.	.... Bulbs irritant poison. Foreign species *U. scilla* a fish poison; Indian representatives also
84. *Juncaceae*— (Rush Family)	1. *Juncus effusus* Linn.	Suspected poisonous to livestock in South Africa. This and other species in India worth investigating
85. *Palmaceae*— (Palm Family) Arecaine, arecolidine, arecoline, guvacine, guvacoline, saponins	1. *Areca catechu* Linn.	Young and undried nut when chewed in access gives rise to temporary giddiness, also gripping and strong intestinal irritation, sometimes resulting in loose motions

Families and active principles	Names of plants	General remarks
85. *Palmaceae*—contd.	2. *Arenga obtusifolia* Mart.	Juice from fruit used by Malays to poison enemies, *A. obtusifolia* stated to be used as fish poison
	3. *Corypha umbraculifera* Linn.	Fruit stated fish poison
	4. *Wallichia disticha* T. Anders.	Watt states that berries and perhaps the leaves irritate the skin
86. *Araceae*— (Aroid Family) Calcium oxalate (acicular crystals), bitter substance, sharp acrid substance, essential oil (alkaloid and saponin in foreign plant)	1. *Acorus calamus* Linn., *A. gramineus* Soland	Roots stated to be used as effective insecticides and insectifuge. Doubtful case reported when the *A. calamus* proved poisonous to camels during the Afghan Campaign, rhizome a medicine but in overdoses produces a violent and persistent emesis
	2. *Alocasia indica* Schott, *A. montana* Schott., *A. odora* (Roxb.) C. Koch (=*A. macrorrhiza* Schott)	Fresh tubers acrid and irritant
	3. *Amorphophallus campanulatus* (Roxb.) Bl., *A. lyratus* Engl., *A. sylvaticus* (Roxb.) Kunth (*Synantherias sylvatica* Schott.)	Fresh tubers acrid and irritant; seeds intensely acrid. Seeds of *A. sylvaticus*, like *Plesmonium*, and fruit intensely acrid
	4. *Arisaema speciosum* Mart., *A. tortuosum* Schott.	Tubers poisonous, insecticidal, fruit also probably poisonous
	5. *Homalomena rubescens* Kunth	Stated to be poisonous
	6. *Lagenandra ovata* (Linn.) Thw. (=*L. toxicaria* Dalz.)	Stated to be very poisonous; also insecticidal
	7. *Plesmonium margaritiferum* Schott.	Crushed seeds produce local anaesthesia; used as a cure for toothache
	8. *Sauromatum guttatum* Schott.	Tubers regarded as very poisonous

	9. *Steudnera virosa* (Kunth) Prain (= *Colocasia virosa* Kunth)	Poisonous
	10. *Thomsonia nepalensis* Wall.	Acrid when fresh
	11. *Typhonium trilobatum* (Linn.) Schott.	Fresh tubers exceedingly acrid
87. *Cyperaceae*— (Sedge Family) Essential oil	1. *Carex cernua* Boott.	Said to be one of the causes of 'vlei' poisoning in cattle in South Africa
	2. *Cyperus longus* Linn.	Regarded as poisonous in South Africa
	3. *Scirpus corymbosus* Heyne.	See *Carex cernua*
88. *Gramineae*— (Grass Family) Cyanogenetic glucosides, hydrocyanic acid, temuline, saponins, oxalic acid, selenium protein (toxic)	1. *Avena fatua* Linn., *A. sativa* Linn.	Good fodder but occasionally deleterious, probably on account of 'hair balls' that are developed in the stomach
	2. *Bambusa arundinacea* Willd.	Fresh young shoots stated to be insecticidal
	3. *Dendrocalamus strictus* (Roxb.) Nees.	Leaves stated to be used to procure abortion
	4. *Lolium perenne* Linn., *L. temulentum* Linn.	Several cases of poisoning, mostly non-fatal in man and animals, from eating the seeds of *L. temulentum*, gastro-intestinal irritation and severe nervous symptoms reported Suspected to be responsible for the production of 'Dikoor', a disease affecting young sheep in Africa Kodra poisoning very similar to *L. temulentum* poisoning, animals suffer much more than men ; animals should be prevented from grazing the crop when ripening
	5. *Panicum maximum* Jacq.	
	6. *Paspalum scrobiculatum* Linn.	

Families and active principles	Names of plants	General remarks
88. *Gramineae*—contd.	7. *Sorghum halepense* (Linn.) Pers., *S. saccharatum* Pers., *S. vulgare* Pers.	Good fodder. Occasional poisoning reported, stunted growth, under drought condition ; frosted leaves, or second growth dangerous
	8. *Stipa* sp. (some)	Believed poisonous ; mechanical action of ' seeds ' may not be overlooked
	9. *Triticum aesativum* Linn.	Under certain conditions deleterious fodder
	10. *Zea Mays* Linn.	Pollen stated to be a possible cause of hay fever, said to be occasionally responsible for deleterious effects, as yet not fully understood