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A PRACTICAL AND NATURAL TAXONOMY FOR CANNABIS*

*Ernest Small*** and Arthur Cronquist****

Summary

Variation in *Cannabis* is evaluated in the context of the confusing systematic history of this genus. Aside from some experimentally produced polyploids, all *Cannabis* is diploid ($n = 10$), and there appear to be no barriers to successful hybridization within the genus. The present pattern of variation is due in large part to the influence of man. Two widespread classes of plant are discernible: a group of generally northern plants of relatively limited intoxicant potential, influenced particularly by selection for fibre and oil agronomic qualities, and a group of generally southern plants of considerable intoxicant potential, influenced particularly by selection for inebriant qualities. These two groups are treated respectively as subsp. *sativa* and *indica*, of *C. sativa*, the only species of the genus *Cannabis*. Within each subspecies two parallel phases are recognizable. The "wild" (weedy, naturalized or indigenous) phase is more or less distinguishable from the domesticated (cultivated or spontaneous) phase by means of an adaptive syndrome of fruit characteristics. The resulting four discernible groups are recognized as varieties.

Introduction

This paper is based largely on garden, laboratory, and herbarium studies of *Cannabis* carried out during the past several years by Small at Ottawa, together with a comprehensive review of the extensive literature bearing on the taxonomy of the genus. Small has previously presented segments of his studies dealing with cytology and breeding behavior (Small, 1972a), chemical variation (Small and Beckstead, 1973a, 1973b; Small et al., 1975), morphology of the achenes (Small, 1975a) and numerical taxonomic analysis (Small, 1974a, Small et al., 1976).

Cronquist's studies, though less intensive than Small's, have led him to the same conclusions, and the two authors have been in frequent consultation since 1972. Cronquist has also been able to examine the type specimens of *Cannabis sativa* L. and *Cannabis indica* Lam., and to lectotypify the names *Cannabis sativa* var. *spontanea* Vavilov and *Cannabis indica* var. *kafiristanica* Vavilov.

It might have been possible to reach the taxonomic conclusions here presented from the literature alone, if due attention had been paid to papers in the Russian language as well as to those in English, German, and French, but such a literature-based interpretation would have lacked the quality of necessity that we believe is provided by the recent work done at Ottawa.

In our opinion the studies reviewed in this paper lead inevitably to the conclusion that *Cannabis* consists of a single highly variable species. This is true regardless of whether one emphasizes traditional morphologic and geographic features, or chemical features, or features of cytology and breeding behavior as essential specific criteria, and whether one analyzes the phenotypic data by inspection or with the aid of a computer. Our taxonomy at the infraspecific level is perhaps debatable, but we believe that it too is strongly supported by the evidence.

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Cannabis is one of the oldest cultivated plants. It has been domesticated for fibre in the bast of the stems, oil in the fruits, and an intoxicating resin produced in epidermal glands (Dewey, 1914; Miller, 1970; Small et al., 1975). The historical association of man and marihuana is treated by numerous authors (e.g. Chopra, 1969; Merlin, 1972; Schultes, 1973). It has been speculated that *Cannabis* once occupied a relatively limited primeval, indigenous range somewhere in central Asia, and that consequent to its domestication its naturalized and spontaneous range increased enormously (de Candolle, 1885; Ascherson and Graebner, 1911; Kirchner et al., 1938; Schultes, 1970; Small, 1972b; du Toit, 1974; Haney and Kutscheid, 1975). It is clear that *Cannabis* was absent from the New World until about 1545 (Small et al., 1975).

Variation in the genus *Cannabis* is due in large part, as will be indicated, to selection by man. Formal taxonomic delimitation under this circumstance is somewhat difficult because of the lack of agreement on the taxonomic disposition of groups which have been substantially influenced by domestication. Further complicating consideration of the taxonomy of *Cannabis* is an extraordinary forensic debate over the number of species meriting recognition. We shall argue, however, that the historical treatment of *Cannabis*, an understanding of the evolution of variation in this genus, the traditions and present concepts of plant taxonomy, and the needs of society all suggest a simple, practical, and natural taxonomy in which only one complex species is accepted.

The classification of variants in the genus *Cannabis* has recently become the subject of heated debate in North American courts. The claim has been made that the name *C. sativa*, which is used to denote cannabis drugs (marihuana, hashish, hashish oil) in most North American legislation, is insufficiently comprehensive to proscribe all kinds of marihuana, because there are other species of *Cannabis*, notably *C. ruderalis* Jan. and *C. indica* Lam., and that these latter species are therefore "legal". In the current *cause célèbre*, some taxonomists who once published expressions of firm position that *Cannabis* comprises only one species, have sharply reversed themselves in testifying on behalf of defendants charged in recent narcotics cases (cf. Schultes et al., 1974 and Schultes, 1969, 1970; cf. Emboden, 1974a, 1974b, and Emboden, 1972). The forensic debate is discussed elsewhere (Small, 1974b, 1975b, 1975c, 1975d, 1976).

The genus *Cannabis* is sharply delimited. Although *Cannabis* and its only near relative *Humulus* were once combined (Scopoli, 1772), there is an absolute and readily perceptible gap between these two genera. The differences are set forth in many places in the general taxonomic literature, and need not be repeated here.

Variation within the genus *Cannabis* is continuous for all characters and sets of characters that have been investigated in any detail. The variation, although continuous, is not unimodal. It is bimodal with regard to one set of characters that relate to domestication as opposed to growth in the wild. It is also bimodal with regard to another set of characters that relate to the purpose for which the plant has been cultivated: fibre (and to some extent oil) on the one hand, and psychoactive drugs on the other. These two independent bimodalities intersect so that four syndromes of more or less closely associated characteristics can be recognized within the genus (Fig. 6).

Critical factors influencing populational structure in *Cannabis* are that the genus is entirely diploid, with $n = 10$ (although some polyploids have been artificially produced; Small, 1972a), that the plants are wind-pollinated, that there appear to be no internal barriers to successful hybridization (Vavilov, 1926 = Vavilov, 1965; Small, 1972a) and that cultivated plants readily escape to the wild (Janischevsky, 1924; Vavilov, 1926; Vavilov and Bukinich, 1929; Scholz, 1957). Two results of the operation of these factors are that wherever *Cannabis* has been cultivated for any length of time it also grows "wild", i.e. without cultivation, and that it is impossible to recognize and delineate any wild population that has not been influenced by hybridization with domesticated populations. If unaltered wild populations exist (which we doubt) they cannot be clearly distinguished from those contaminated by the influence of domestication.

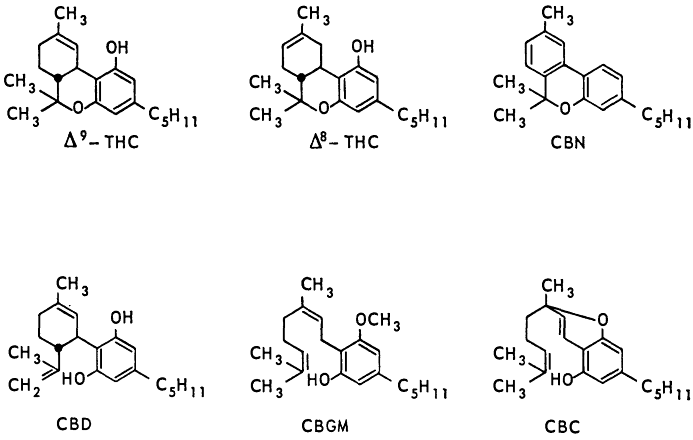


Fig. 1. Molecular diagrams of cannabinoids mentioned in this paper. THC = tetrahydrocannabinol, CBN = cannabinol, CBD = cannabidiol, CBGM = cannabigerol monomethyl ether, CBC = cannabichromene.

In our opinion the key to comprehension of variation in *Cannabis* and the taxonomic literature about it, is found in three interacting processes: (a) conscious selection by man for traits of agronomic value, principally for fibre or drug content, coupled with conscious and unconscious selection for fruit characteristics; (b) continuous genetic interchange between plants growing under, and outside of cultivation, by means of domestication of wild populations, escape from domestication, and hybridization between wild and domesticated plants, facilitated by wind pollination; (c) selection by the environment, at the morphological level particularly for adaptive fruit characteristics.

Agronomic Properties and Taxonomic Delimitation

One of the two principal agronomic products of *Cannabis* is an intoxicating resin synthesized by the plant in epidermal glands. Graft experiments between strains of *Cannabis* with different resin characteristics, and with *Humulus*, suggest absence of transport of resin from one part of the plant to another (Crombie and Crombie, 1975). Multicellular secretory glands are widespread over the surface of the epidermis of *Cannabis*. These are concentrated on the adaxial leaf surfaces, where they are usually sessile, and in the inflorescence. The abaxial surface of the large bract which envelops the fruit is densely covered with glands, many of them stalked (Hammond and Mahlberg, 1973). The resin secreted by these glands is composed mainly of a class of terpenoid chemicals called the cannabinoids cannabinols (Fig. 1), of which several are intoxicant. Of the intoxicant chemicals, Δ^9-tetra-hydrocannabinol (Δ^9-THC) usually predominates. (By a different, but also commonly used chemical nomenclature, this is referred to as Δ^1-THC). A number of additional intoxicating isomers of THC, particularly Δ^8-THC, are often found in *Cannabis* resin, but usually in very limited amounts. (However, C. E. Turner has found (pers. com.) that C_3 (rather than the usual C_5) side-chain homologues of THC are sometimes the most prominent intoxicant cannabinoids of some intoxicant races.) On a relative weight basis, cannabinoid content increases in the following order: fruits (excluding bracts), roots, larger stems, smaller stems, older and larger leaves, younger and smaller leaves, flowers, fruit bracts (Fetterman et al., 1971; Small, unpublished). Recent comprehensive reviews of cannabinoid chemistry have been provided by Neumeyer and Shagoury (1971), Mechoulam (1973) and Parker and Stembal (1974).

Until fairly recently it was widely thought that the intoxicant properties of the resin of *Cannabis* were extremely subject to environmental modification. It was believed that hot, dry climates are necessary to elicit the psychoactive properties of the resin, and that cool, damp climates have very limited potential for eliciting drug properties (e.g. Bouquet, 1950, p. 19). It now appears, however, that the intoxicant characteristics of *Cannabis* resin are reasonably conservative (Nordal and Braenden, 1973; Small et al., 1975; cf. Haney and Kutscheid, 1973; Boucher et al., 1974; Coffman and Gentner, 1975). Primarily genetic, as opposed to primarily environmental control of cannabinoid characteristics, is an essential factor in our taxonomic treatment of *Cannabis*. It also appears that the qualitative characteristics of the resin are reasonably consistent in different parts of the plant (e.g. Rasmussen and Svendsen, 1973). However, recent work by Turner and his colleagues at the University of Mississippi suggests that single chemical analyses of certain strains of *Cannabis* should be interpreted cautiously. In some strains, marked diurnal and seasonal qualitative and quantitative variation of the cannabinoids have been observed (Turner et al., 1973b, Turner et al., 1975a; cf. Phillips et al., 1970; Latta and Eaton, 1975). Thousands of plants have been examined chemically at Ottawa, however (Small and Beckstead, 1973a), and the taxonomic value of THC content has been clearly demonstrated.

In plants grown at Ottawa it was found that quantitative variation is primarily determined by genetic stock, length of vegetative growth and state of maturity. Resin content (on a relative weight basis) increased to a maximum shortly after flowering, with some difference in peaking of males and females. In northern latitudes the shorter season for vegetative growth provides some limitation on the concentration of resin which can accumulate. Honma et al. (1971) made similar observations on *Cannabis* grown in Japan, and noted that resin content decreases on withering. Once the plants are harvested, oxidative changes occur slowly, changing the composition of the resin (Turner et al., 1973a; cf. Coffman and Gentner, 1974). In particular, THC concentration decreases, and the concentration of the non-intoxicant cannabinoid, cannabinol, increases.

Quantitative evaluation of cannabinoid content found in the literature must be treated with circumspection, because (1) different laboratories have used different techniques, sometimes resulting in quite discordant findings on an absolute (but not a relative) basis (Le Dain et al., 1972); (2) maturity and storage conditions affect quantities present; and (3) different parts of the plant contain different concentrations of the cannabinoids, and different investigators sample differently. Much literature reporting cannabinoid contents refers to "dried flowering tops". Great differences in concentrations (i.e. reports of quantities present on a relative basis) result, depending on how such material is prepared: if the achenes and larger twigs are removed, THC concentrations are of course much higher.

It will be noted that we arbitrarily adopt a concentration of 0.3% Δ^9-THC (dry weight basis) in young, vigorous leaves of relatively mature plants as a guide to discriminating two classes of plants. This is based on standard-grown material in Ottawa in gardens, greenhouses and growth chambers, and of course on our analytical techniques. Dr. C. E. Turner, who has conducted extensive chemical analysis of *Cannabis* at the University of Mississippi, has agreed (pers. com.) that this is a reasonable figure to discriminate two classes of plants. We found that generally approximately 2% of the dry weight of young leaves of mature plants, or of the average dry weight of the softer parts of the female flowering plant (leaves, small twigs, flowers) is comprised of cannabinoids. Since CBD (cannabidiol, the most common non-intoxicant cannabinoid) and THC collectively usually compose the bulk of the cannabinoids present, one can crudely adjust literature reports of cannabinoid concentration for comparison with our values on the basis that the concentration of CBD and THC should sum to roughly 2%.

It has been shown that two widespread classes of plants can be discerned with respect to intoxicant properties (Small and Beckstead, 1973a, 1973b). Plants originating from fairly southern countries (approximately south of latitude 30° N.), where there has been a long history of the use of *Cannabis* for drug purposes, are characterized by (a) resin containing a relatively high proportion of intoxicating cannabinoids, often more than half of the total, usually mostly THC, (b) considerable resin in male plants as well as in females (on a relative weight basis; females are usually larger than males) and (c) relative slowness of induction of flowering by short day length. In contrast, plants originating from more northern locations, where *Cannabis* has been used primarily as a source of fibre and oil, are characterized by (a) resin composed primarily of non-intoxicating cannabinoids, usually mostly CBD, (b) notably higher resin concentration in female plants than in male plants, and c) relative rapidity of induction of flowering by short day length. It should be understood, however, that chemically intermediate plants are widespread (Small and Beckstead, 1973a; Krishnamurty and Kaushal, 1974).

Although the general geographical distribution of psychoactive constituents in *Cannabis* is now fairly well understood, additional geographical evaluation of cannabinoid distribution is still very desirable. The cannabinoids are substantially carboxylated in fresh material, and are neutralized after harvest on ageing (Grlic and Andrec, 1961; Kimura and Okamota, 1970). (It is to be understood in this paper wherever cannabinoid concentrations are given that the sum of neutral and carboxylated fractions is denoted). It has been reported that a relatively greater proportion of the cannabinoids is decarboxylated in the living plants in southern strains (Mechoulam, 1970). Strains from north-eastern Asia frequently have trace amounts of the otherwise rare cannabinoid, cannabigerol monomethyl ether (Small and Beckstead, 1973a, 1973b). High-THC strains from southern regions frequently show complete absence of CBD (references in Small and Beckstead, 1973a, 1973b; Small et al., 1975), and often have appreciable quantities of the minor cannabinoid, cannabichromene (Turner et al., 1975b). There are good indications that a number of minor cannabinoids may exhibit a geographical pattern (Turner et al., 1973c; Strömberg, 1971, 1972a, 1972b, 1974b). A geographical pattern is also somewhat probable for the abundant terpenes present (Martin et al., 1961; Nigam et al., 1965; Hood et al., 1973; Strömberg, 1974a) and for the flavonoids (Gellért et al., 1974).

Lamarck (1785; see Breistroffer (1948) for evidence that the commonly cited date of 1783 is inapplicable) produced the first nomenclaturally significant recognition of the two basic kinds of plants of *Cannabis*, and he did not with a clear indication that the distinction was based on agronomic properties. "Chanvre cultivé" (*C. sativa*) was described as having some narcotic properties, but as being cultivated primarily for other qualities. This taxon was described as cultivated extensively in Europe for the fibre in the stems, and for the fruit. It had become naturalized in Europe. Lamarck pointed out that Linnaeus indicated *C. sativa* "grew naturally" in "Persia". Stearn (1974) has, however, determined that Linnaeus was familiar with the fibre cultigens of Europe, and accordingly Stearn designated a fibre cultivar as the lectotype of the name *C. sativa* L. in contrast with "Chanvre cultivé", "Chanvre des Indes" (*C. indica*) was described by Lamarck as having too thin a bark to furnish sufficient fibre for agricultural exploitation; rather this taxon had marked inebriant properties, grew, and was extensively used as an intoxicant in the East Indies. (The descriptive binomial *Cannabis indica* predated Lamarck's use of this name (e.g. Rumpf, 1750). Lamarck thought *C. indica* could be distinguished from *C. sativa* by possession of alternate as opposed to opposite leaves, and narrower leaflets. *Cannabis indica* was described as being smaller, more branched, and possessing a firmer, nearly cylindrical stem, and linear-lanceolate, acuminate leaflets.

Clearly Lamarck had in mind fibre and oil cultivars in his conception of *C. sativa*, and inebriant cultivars in his conception of *C. indica*. The tallness, lack of branching, hollowness of stem, and nature of bast are all agricultural features of fibre cultivars, maximizing quality, length, and obtainability; the absence of these features in inebriant cultivars simply reflects the different selective history of such plants. Lamarck's supposition that the two taxa can be distinguished on the basis of leaf insertion is widely acknowledged to be incorrect.

The intoxicant distinctiveness of *C. indica* led to the frequent use of this binomial by writers wishing to stress inebriant properties of *C. sativa*. Indeed, the binomial was transformed by pharmacologists from a name to a term indicating, officinally (sic), drug preparations from *C. sativa* (e.g. Ascherson and Graebner, 1911; Moll et al., 1923). Not surprisingly, this led to a great deal of confusion.

Although there has long been considerable appreciation of the distinctiveness of low-intoxicant plants contrasted with high-intoxicant plants, there has been relatively little agreement on whether and how the two groups could be distinguished morphologically, and how they should be treated taxonomically. Early students of the southern, intoxicant plants (e.g. Dietrich, 1842; Christison, 1850; Dukerly, 1866; Watt, 1889) saw no merit in granting this group separate formal recognition. Persoon (1807) reduced *C. indica* to a variety of *C. sativa*, but did not validate the combination; Wehmer (1911) seems to have been the first to do so.

Alphonse de Candolle (1869) reduced *C. indica* to synonymy with *C. sativa*, but he recognized four groupings (α, *Kif*; β, *vulgaris*; γ, *Pedemontana*; δ, *Chinensis*) which he described as units of lesser status than varieties, possessing more or less constant heredity, but subject to considerable environmental modification. Of de Candolle's forms, *Pedemontana* and *Chinensis* are clearly referable to northern fibre cultivars, *vulgaris* is a mixture of the northern low-intoxicant and southern high-intoxicant classes of plant, and *Kif* is clearly referable to the southern intoxicant kind of plant (cf. Dukerly's (1866) and Mikuriya's (1967) discussions of "Kif").

In a brief treatment, Vavilov (Vavilov and Bukinich, 1929, pp. 380-382) placed some heavily-branched, large-leaved plants he encountered in cultivation in Afghanistan for drug purposes, in *C. sativa* L. In doing so, he was consistent with Lamarck in that the latter did use wide leaflets (as are usually present in the large-leaved drug cultivars of Afghanistan) as diagnostic of *C. sativa* as opposed to *C. indica*. However, he was inconsistent with Lamarck in that the latter indicated *C. indica* had much higher inebriant potential than *C. sativa*. Vavilov indicated that *C. indica* could be distinguished by small leaves, small fruit, and low growth (not more than one metre in height). Subsequently Serebriakova and Sizov (1940) maintained Vavilov's distinction between *C. sativa* and *C. indica*. "Indian hemp" (*C. indica*) was said to be used for the extraction of narcotic substances, and to be distributed in India, Afghanistan, Iran, Turkey, Syria, Israel and North Africa. In contrast with "common hemp" (*C. sativa*), Indian hemp was described as being usually more branched, and having narrower, smaller leaflets, and shinier seeds. Like Vavilov, Serebriakova and Sizov included some high intoxicant plants within *C. sativa*, contrary to the traditional separation of *sativa* and *indica* (at whatever taxonomic level) on the basis of the fibre and oil properties of the former and intoxicant properties of the latter.

Zhukovsky (1962, 1964) and Schultes et al., (1974) recognize three species of *Cannabis, C. sativa, C. indica*, and *C. ruderalis*. However, the nature of homologous variation of fruits is not clearly described by these authors (*vide infra*), and accordingly their attempt to characterize the species on features of the fruit is confused. Our extensive contact with Dr. Schultes leads us to suppose that his conception of *C. indica* at present is very narrow, and is heavily influenced by his acquaintance with a large-leaved variant that he collected in Afghanistan (illustrated on p. 359, Schultes et al., 1974). Although we would assign this variant to a broader conception of the intoxicant taxon, Vavilov in 1929 (the date of the last publication in which he dealt with the taxonomy of *Cannabis*) would probably have assigned it to *C. sativa* because of its large leaves, and Lamarck might have been tempted to do so in view of its very wide leaflets.

For more than a century, prior to the eruption of the forensic-taxonomic debate in 1972, very few taxonomists (aside from some in the Soviet Union) accorded much respect to the formal taxonomic distinction of any of the variants within *Cannabis*, even the obvious grouping into northern, low-intoxicant fibre and oil variants and southern, high-intoxicant "narcotic" variants. This fact is epitomized by recent publications of some of those most active for the position of the defense in the current forensic debate, prior to their association with the legal issue, and their transformation of opinion. Schultes wrote in 1970: "Botanists now generally agree that *Cannabis* is a monotypic genus, a genus with one species, *C. sativa,* that there cannot be recognized any true botanical varieties within this species, and that this one species has diversified into a great number of ecotypes and cultivated races. Modern taxonomists, thus, are in agreement with Linnaeus' treatment of the genus." Emboden wrote in 1972: "Despite much writing to the contrary there is but a single species of *Cannabis* – popularly called marihuana – and that is *Cannabis sativa* L., the cultivated hemp, so named by Linnaeus in 1753."

Recent studies have indicated that when plants are grown under standardized circumstances, plants of the northern low-intoxicant type can be discriminated from plants of the southern high-intoxicant type by means of multivariate analysis of many morphological attributes (Small, 1974a; Small et al., 1976). However, considerable mathematical computation is required in using this way of distinguishing the groups, which could not be identified by practical visual means. In any case, because of the far greater variability of plants grown under less rigorous control, this method could not be used to distinguish the two classes of plants in the wild. Moreover, there is a strong possibility that the discrimination observed in the garden-cultivated material in the numerically oriented studies was in considerable part due to the late-maturing property of the high-intoxicant races examined, and the consequent simultaneous influence of many attributes.

Horticultural Variants

There are many names for horticultural variants of *Cannabis,* but very few of these have been validly published as formal taxa under the International Code of Botanical Nomenclature. Serebriakova and Sizov (1940) presented a quasi-formal treatment recognizing numerous variants at several infra-specific levels. This scheme was adopted by several hemp monographers (e.g. Ceapoiu, 1958; Kender, 1962), and appears to provide a useful, if artificial guide to cultivars. The primary classification into "*C. sativa*" and "*C. indica*", followed by the splitting of *C. sativa* into two subspecies based on whether wild or cultivated, is in conceptual agreement with our own treatment, although we differ with them as to the rank and precise circumscription of these groups.

Several names have been used to some extent in the horticultural literature. These include *C. himalayana* (Zinger, 1898, p. 207), *C. gigantea* (Delile, 1849; Crévost, 1917), *C. sativa* f. *gigantea* (Voss, 1896), *C. chinensis* (Vilmorin, 1851), *C. sativa* var. *atripurpurea* (Lonachevsky and Kotov, 1952), and *C. pedemontana* (Camp, 1936; cf. de Candolle, 1869). Geographical epithets are often used very casually, for example *C. americana* (Houghton and Hamilton, 1908; Wehmer, 1911), and *C. germanica* (My, 1950), for neither of which was there any attempt at formal publication or description as species. Dewey (1914) and Schreiber (1957) provided analyses of hemp cultivars available some decades ago; mercifully neither attempted a latinized nomenclature.

The Distinction between "Wild" and "Domesticated", and Taxonomic Delimitation

It is well recognized that cultivated plants frequently coexist in complex relationships with their wild progenitors (Anderson, 1952; Baker, 1972, 1974). One may distinguish, theoretically, "domesticated" plants (those altered by artificial selection for desired properties), from aboriginally "wild" plants (those unaffected by such selection). As well, it is sometimes desirable to distinguish "weedy" plants, keeping in mind that these may be essentially identical to the domesticated or wild (sensu stricto) phase, or may represent a product of genetic mingling of these phases. (Harlan and de Wet in 1965 expressed the belief that most weedy biotypes coexistent with cultivars are derived from the latter, rather than from more aboriginal unaltered stocks). One may recognize several situations, theoretically (cf. van Steenis, 1957, pp. CXCVIII - CCIII; Nicholson et al., 1969, pp. 192-193): (1) a simple condition, in which domestication has led to the creation of a cultivated phase so modified as to be incapable of survival outside of cultivation. Such plants may coexist with essentially unmodified progenitors persisting in aboriginal sites. Substantial divergence between the wild and cultivated phases, and the lack of hybridization between them, facilitate morphological separation and taxonomic recognition at some desired rank. Extinction of the wild phase simplifies the situation further. (2) Situations of intermediate complexity, in which there is hybridization and introgression between the wild and cultivated phases, possibly coupled with naturalization and the evolution of weedy biotypes. Persistence of basically unmodified aboriginal kinds of plants in a perceptibly indigenous range still allows taxonomic distinction, but perhaps debatably. (3) A massively panmictic situation, with widespread hybridization and introgression between the wild and cultivated phases, substantially modifying aboriginal populations, or resulting in sufficient confusion to preclude reliable recognition of "primitive", unmodified stocks, and their aboriginal indigenous range.

Cannabis clearly belongs to the third situation. *Cannabis* is one of the most ancient of cultivated crops, and has been domesticated for perhaps as long as 8500 years (Schultes, 1969; Schultes and Hofmann, 1973). Although it has been speculated that *Cannabis* is indigenous in central Asia, there is no agreement on even an approximate location (Schultes, 1970). There are good reasons why one would not expect to find unaltered extant *Anlagen* of domesticated *Cannabis*. *Cannabis* has been observed to form spontaneous populations wherever it is grown, and weedy biotypes are extensively established throughout the world. The wind pollination of plants such as *Cannabis* facilitates long-distance genetic interchange. Wind-pollinated plants with pollen grains the size of *Cannabis* (about 25 μ in diameter) can effectively disperse pollen for hundreds of miles (e.g. Erdtman, 1937; Sack, 1949). Significantly, *Cannabis* produces pollen copiously. Further, all studies of interfertility reported in *Cannabis* to the present indicate absence of sterility barriers between wild and domesticated populations (Vavilov, 1926; Small, 1972a; Davidyan, 1972). Given the possibilities of long distance hybridization, dispersal and establishment, and the long-continued modification and distribution of *Cannabis* by man, we believe it is unlikely that one could find unaltered aboriginal populations. Even if relatively unaltered aboriginal genotypes are still extant, there are presently no non-circular means of identifying these, since we simply cannot establish whether a given variant occupying a discrete geographical range represents aboriginal material, or is the partial consequence of domestication (note particularly the numerous variants with discrete distribution ranges described by Nikiforov, 1963). Certainly at present there is no reason to suppose that any of the specific names available in *Cannabis* have been based on material unaffected by domestication. Indeed the distinction between wild and domesticated material has only recently been carefully addressed. The widespread confusion in the early literature regarding whether *Cannabis* was "indigenous" or "spontaneous" in various parts of its range is detailed by Janischevsky (1924) and Vavilov (1926).

Just as selection either for fibre and oil attributes, or for drug properties, has resulted in the evolution of kinds of plants, so the different selective regimes under cultivation and in the wild may be expected to result in kinds of plant. In particular, it is well known that attributes of propagules, particularly those influencing distribution, are especially subject to change depending on exposure to, or release from domestication. Indeed, many parallels exist between the situation in *Cannabis* (*vide infra*) and other domesticated species with similar wild relatives (examples in Harlan et al., 1973).

The differences in propagules between "wild" and domesticated plants of central Russia were carefully examined by Janischevsky, who subsequently referred domesticated plants to *C. sativa*, and wild plants to *C. ruderalis* or *C. sativa* var.

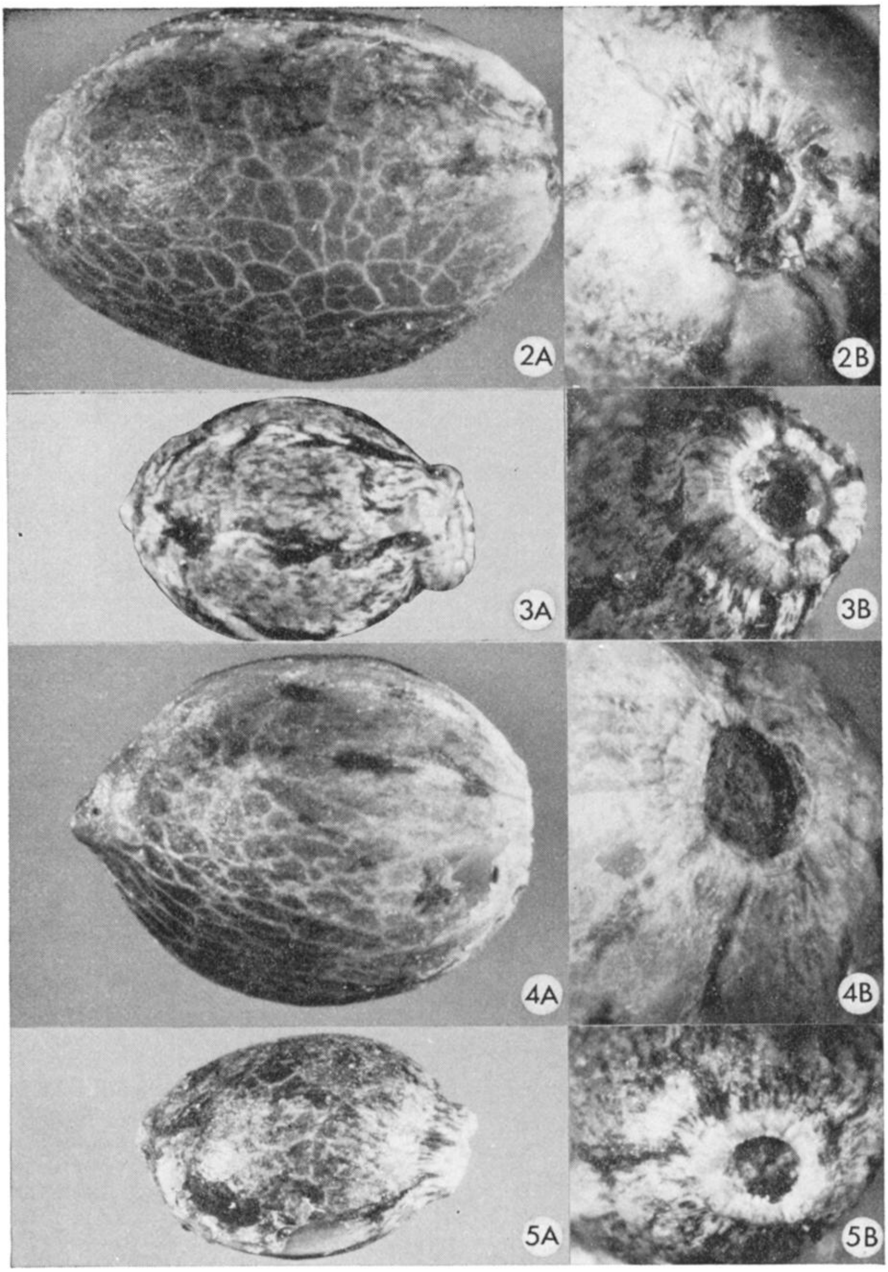
ruderalis (Janischevsky, 1924). Janischevsky's work represents a considerable increase in understanding of variation in *Cannabis*. He noted that in contrast with fruits of "wild" plants, the achenes of domesticated strains of *Cannabis* are larger, relatively blunt at the point of attachment, and relatively barren of an adhering papery layer homologous with the perianth. In contrast, fruits of wild plants are smaller, covered by tightly adhering mottled perianth, and have a prolonged base. As might be expected, mature fruits from wild plants disarticulate readily and germinate irregularly, whereas fruits from domesticated plants are somewhat persistent on the plants at maturity and germinate promptly when planted.

Janischevsky carefully examined the nature of the adherent perianth. He explained its presence in wild plants as reflective of the value of camouflage in that the perianth is marbled with dark and light areas. He noted that the interior of the somewhat elongated base of the fruit of wild plants (which he interpreted as being part of the receptacle), is characterized by oily cells, and he found some evidence for a mutualistic relationship with the bug *Pyrrhocoris apterus* L., which fed on this basal tissue and distributed the achenes. Lonachevsky and Kotov (1952) state that a similar relationship exists with beetles of the genus *Harpalus*. The occurrence of relatively large fruits in domesticated stocks parallels the situation in many other plants with coexistent wild and cultivated phases (references in Baker, 1972).

The morphology of the fruit of *Cannabis*, and the layers which cover it, are easily misunderstood and generally have been inadequately described in the literature. A green floral bract envelops the young pistil, except for the exserted stigmas, and grows with the developing fruit, loosely enclosing it at maturity. The abaxial surface of this bract is densely covered with secretory and cystolith hairs. The perianth arises from the base of the young ovary, and grows around the ovary, adhering closely to it. The perianth is merely a thin, hyaline membrane, which is mottled with dark areas that are more or less associated with the veins. In cultivars, the perianth is often not present at maturity, or is evidenced only by fragments of papery material adhering to the achene. Usually traces of this papery material are present at the base of the achene, reflecting the fact that growth of the perianth in cultivars is frequently restricted to the base. (Cultivars have been described, however, in which the achene is covered by an adherent perianth, as in wild plants (references in Scholz, 1957)). When the perianth is missing, reticulate venation is easily seen. This is due to veins embedded in the mesocarp of the fruit. Many authors are familiar with only the domesticated kind of achene, and have confused this venation with the "marbling" due to the dark and light areas of the papery perianth. The "marbling" is easily seen in the wild kind of achene, since the perianth tends to adhere very well over the surface of the exocarp, obscuring the venation in the mesocarp. The frequent use of the term "mosaic" by some authors obviously reflects confusion concerning whether the "marbling" of the papery perianth, or the network of venation of the mesocarp is being denoted. Note that the venation is obvious in the domesticated achenes shown in Figs. 2 and 4, whereas the marbled perianth is obvious in the wild achenes shown in Figs. 3 and 5. Further details of the structure and variability of the fruits are found in Small, 1975a.

Zhukovsky (1964) refers to the fruits as "spurious nutlets", giving as his reason the fact that the perianth is often fused to the exocarp. Zhukovsky was under the mistaken impression that the perianth layer *per se* conferred hardness on the fruits of wild plants. Vavilov (1926) asserted that the hardness characteristic of fruits of wild plants was due to pericarp thickening in the basal part of the fruit. Janischevsky (1924) attributed the hardness of wild fruits to thickening of the ribs of the achenes. Our studies indicate that hardening may be attributable to one or both kinds of modification in different wild races. Also, small wild fruits have walls as thick as larger domesticated fruits, and therefore in proportion to the size of the fruit, are better protected.

Disarticulation of the fruits from the plants is in small part due to a change in attitude of the large enveloping bract, which loosens its hold on the achenes. This



Figs. 2-5. Representative achenes of the varieties of *Cannabis* recognized in this paper. A = side view, X 18; B = oblique view of base, X 26. 2- *C. sativa* subsp. *sativa* var. *sativa* (fibre cultivar from Romania, *E. Small Cannabis voucher 195*, DAO). 3- *C. sativa* subsp. *sativa* var. *spontanea* (Dzhungariia municipality G. Kul'dzhi, U.S.S.R., *Larionov 65*, MW). 4- *C. sativa* subsp. *indica* var. *indica* ("narcotic" cultivar collected from Khandua on 28-X-1893 by Indian Hemp Drugs Commission, accession 423376, CAL). 5- *C. sativa* subsp. *indica* var. *kafiristanica* (Sikkim, India, *Cave 655*, BM).

bract firmly holds immature fruits, and is often found persistently hooding the mature fruit of cultivars. However, it is the disarticulation features at the base of the fruit which are of particular importance to wild plants of *Cannabis*. The elongation or constriction of the base of the fruits of wild plants to produce a short, stout stipe is likely an adaptation facilitating shattering. Disarticulation is often said to be by means of a "joint" or at a "dehiscence zone" in fruits of wild populations, with a "circular torus" (Sojak, 1960), or "horseshoe" (Vavilov, 1922; Janischevsky, 1924), or "callus-like ring" (Schreiber, 1957) left evident at the base. Such descriptions are of limited value in distinguishing the wild and domesticated phases. All *Cannabis* fruits are "jointed" at their base, where disarticulation occurs by abscission of the fruit from the receptacle. When the abscission occurs in such a way as to leave a hollow at the base of the fruit (as often but not invariably occurs with fruits having an elongated base, and as occurs less frequently in fruits with a blunt base) then one does find a raised torus. Some authors (e.g. Zhukovsky, 1964; Emboden, 1974b; Schultes et al., 1974) have characterized the elongated base of the fruits of wild plants as a "caruncle". This term is applicable only by analogy, since in botanical usage it refers to a protuberance near the hilum of a seed (Jackson, 1905; Featherly, 1965; it may be noted that the fruits of *Cannabis* are generally called seeds in common usage.)

Vavilov (1926) accepted Janischevsky's observations concerning the differences between propagules of wild and cultivated plants of *Cannabis*, but because he was well acquainted with the marked intergradation which occurs between these phases he referred *C. ruderalis* merely to a variety, var. *spontanea*, which he himself had recognized earlier (Vavilov, 1922). *Cannabis ruderalis* Janischevsky was accepted by a number of Russian authors (e.g. Sukhov, 1930; Yarmolenko, 1936). Serebriakova and Sizov (1940) in effect raised the rank of var. *spontanea* to that of a subspecies, but did not validly publish the subspecific combination. Scholz (1957) accepted subsp. *spontanea*, but did not validate it nomenclaturally. Scholz' study represents an abbreviated but competent repetition of Janischevsky's work, dealing with fruit characteristics of wild and cultivated plants of Europe. Figures 4 and 10 of Small 1975a represent wild material supplied by Scholz (corresponding to E. Small voucher 28).

Vavilov, the father of the Law of Homologous Series (note Vavilov, 1949-50), substantially understood that parallel variation is found between the wild and domesticated phases of both the southern, high-intoxicant strains, and the northern, low-intoxicant strains. Vavilov recognized Janischevsky's wild fruit syndrome in the uncultivated plants he found growing in eastern Afghanistan. He noted the very small size of fruits of the region, as did Small (1975a). In 1929 Vavilov (Vavilov and Bukinich, 1929) described "wild" plants of eastern Afghanistan as *C. indica* var. *kafiristanica*. He considered these plants to be characterized vegetatively by their small size, profuse branching, short internodes, and small leaves with tapered, obovate leaflets. He went on to point out that the plant he had described in 1926 as *C. sativa* f. *afghanica* is actually transitional between his *C. indica* var. *kafiristanica* and domesticated *C. indica* of India, and he made the new combination *C. indica* f. *afghanica*. (In Fig. 268 of Vavilov and Bukinich's 1929 book the caption is inconsistent with the text in referring to forma *kafiristanica* and var. *afghanica*. Clearly the ranks are reversed in the caption. This error was not corrected in Fig. 167 of a recent reprint of Vavilov's work (Vavilov, 1959).

The best exemplars of the domesticated fruit syndrome among inebriant forms are found in herbarium specimens collected from ganja (marihuana) fields in India, before the turn of the century, when domestication of drug strains of *Cannabis* in India reached its zenith (Young et al., 1893-94; note cited CAL specimens, and Fig. 4). Although *Cannabis* is still widely cultivated for intoxicant properties in southern countries, the increasing condemnation of it has led to less intensive continued selection, and, on the whole, intoxicant cultivars are not as fully domesticated as are fibre cultivars. Nevertheless fruits of most strains used in the illicit narcotics trade today conform reasonably well to Janischevsky's domesticated syndrome, as do virtually all fibre and oil cultivars. Material collected outside of cultvation reveals a variety of stages transitional to the wild fruit syndrome. We interpret the domesticated fruit syndrome in plants collected outside of cultivation as indicating recent escape from domestication, and we interpret the transitional stages as reflective of various degrees of progressive adaptation (or re-adaptation) to exclusively wild existence. These interpretations are speculative, but not unreasonably so. In conformity with Vavilov's observation (1926) that the spectrum of variants found in nature for the northern races represents continuous, transitional variation, Small (1975a) found the same situation applies to the southern, intoxicant races.

Limitations of Taxonomic Value of Some Characters

Height is only of limited utility as a taxonomic characteristic in *Cannabis*. Extreme variation is possible because of environmental modification. Also, short days initiate flowering, and plants are photoperiodically adapted to terminate growth in relation to the length of their local growing season. Intensive studies of ecotypic variation in the U.S.S.R. have indicated that populations from more northern areas are more easily induced to flower than southern populations, and accordingly there is a geographic ecocline within subsp. *sativa* in the U.S.S.R. with respect to height, the northern forms being shorter than the southern forms (Davidyan, 1972).

As noted earlier, agronomic traits (tallness, hollow stems, limited branching) have been artificially selected, and the introgression of such traits into the wild phase of *Cannabis* has resulted in an extraordinary range of morphological variants (note Nikiforov, 1963). Taxonomic delimitation has hitherto been based almost exclusively on these attributes, and more particularly on the fruit characteristics detailed earlier. An extensive numerical analysis of numerous attributes of hundreds of variants of *Cannabis* grown under standard garden conditions (Small et al., 1976) failed to suggest taxonomically useful character combinations. At present we perceive no evidence warranting formal recognition of any taxa other than the groups we recognize here.

The anatomical differences reported by Anderson (1974) between one stem collected in Afghanistan and another collected in Kansas require comment. This finding has been repeatedly represented in courts as so significant as to warrant almost by itself recognition of separate species. One might indeed expect to find differences between the stems of an intoxicant variant (from Afghanistan) and a fibre variant (from Kansas), but we think that Anderson's limited sampling hardly suffices to evaluate environmental modification or populational variability. Most of the anatomical differences that Anderson found are what one might expect as a result of the long-continued selection of var. *sativa* for differential rottability of the stems, and the absence of such selection in subsp. *indica*. The commercial fibres of *C. sativa* are in the phloem. These are extracted at the proper stage of rotting of the stem, when the phloem fibres are still relatively unaffected, but other initially firm parts have been softened by rotting. Anderson found that the libriform fibres of the xylem of what he called *C. indica* are "typical, lignified libriform fibres", whereas those of what he called *C. sativa* "are dimorphic, with successive tangential bands of thick-walled fibres alternating with bands of thin-walled fibres. They have irregularly shrunken secondary walls (more pronounced in the thick-walled fibres) and are termed gelatinous". Accordingly, the fibrous part of the xylem in the fibre races is disrupted by soft tissue that might be expected to rot relatively easily. Anderson found that "vessels in *C. indica* tend to occur in radial chains; whereas those of *C. sativa* usually occur singly". Being separated from each other, the vessels of the fibre races would be more easily dispersed by rotting of the intervening cells. Anderson also found that the vessels of "*C. indica*" have thicker walls than those of "*C. sativa*". Again, easier rotting of the fibre races is suggested.

Nassonov (1940) examined anatomical features in far larger and more varied samples of *Cannabis* than Anderson. He found some of the same differences, and others as well, but he found that the various features overlap and intergrade so thoroughly as to preclude their use for taxonomic segregation, and he referred all variants (including both drug and fibre races) to the single species *C. sativa*.

In several court cases it has been claimed that the inherent conservativeness of wood features makes permissible the recognition of species based on any perceived differences. With regard to the anatomy of the stem of *Cannabis*, which has been altered by selection under cultivation, we think that it is the taxonomic evaluation of the characters, rather than the characters themselves, that should be conservative. One of us (Small) is now engaged in the study of another species (*Daucus carota* L.) in which selection under cultivation has obviously caused great changes in the anatomical structure of the root.

We recognize that some characters turn out to be taxonomically useful more often than others, but in each individual case the determination should be made *a posteriori* rather than *a priori* (Linnaeus, 1751, paragraph 169). We have indeed a fine and generally admitted example of this fact in the leaf arrangement of *Cannabis*. Emboden (1974a, altered slightly and published as 1974b) endorses Lamarck's erroneous use of alternate versus opposite leaf arrangement as a means of distinguishing two putative species. However, the situation with regard to leaf arrangement in *Cannabis* was correctly evaluated as far back as 1832, by Roxburgh, who wrote: "I perfectly agree with Willdenow, in thinking all the varieties, if even such they can be called, centre in one species. From the same seed and even on the same plant, I have found the leaves both opposite and alternate". Although the arrangement of the leaves is often very useful at generic or suprageneric levels in other groups, the leaves in *Cannabis* are opposite toward the base of the stem, and generally alternate toward the top. *Helianthus annuus* L., and a number of other species of *Helianthus*, show a similar ontogenetic change in the arrangement of the leaves.

We have found no significant support for the contentions of a number of authors regarding the taxonomic importance of certain additional characters in *Cannabis*. Scholz (1957) indicated ruderal plants have smaller pollen grains than cultivated plants. However, we found considerable variation in pollen size, and no consistent differences between ruderal and cultivated plants (even considering material kindly supplied by Scholz). Indeed, there are presently no morphological characters known that can be used generally to distinguish wild and cultivated male plants, and mature females are essential for distinction. Scholz also claimed that the female inflorescence is more compact in cultivated than in wild plants. This distinction is, of course, common between wild plants and their cultivated relatives. Although we have observed many cultivars with distinctly compact inflorescences, this feature is too variable for consistent diagnosis. We find no support for the contention of Serebriakova and Sizov (1940) that *C. indica* has "shinier" fruits than *C. sativa*.

Taxonomic Philosophy and Cultivated Plants

The classification of wild progenitor-cultivar-weed complexes has promoted considerable discussion (e.g. Jirasek, 1966; Baker, 1970; Hawkes, 1970; Harlan and de Wet, 1971; de Wet and Harlan, 1975). There is some measure of agreement on (a) the need to separate the taxonomic treatment of wild-cultivated-weed complexes from the traditional treatment of strictly wild groups, and on (b) the general unsuitability of extensive formal infraspecific recognition of variants. However, there is no consensus on general guidelines for taxonomic disposition. This situation likely reflects as much the existence of inherent populational complexity unconducive to simple pigeon-holing, as it does variation in taxonomic philosophy. Given the range in variational patterns that has been encountered in wild-cultivated-weed complexes, it seems appropriate to address the nature of variation per se in given groups, rather than attempt to force all populations into a universal classification pattern either formal or informal.

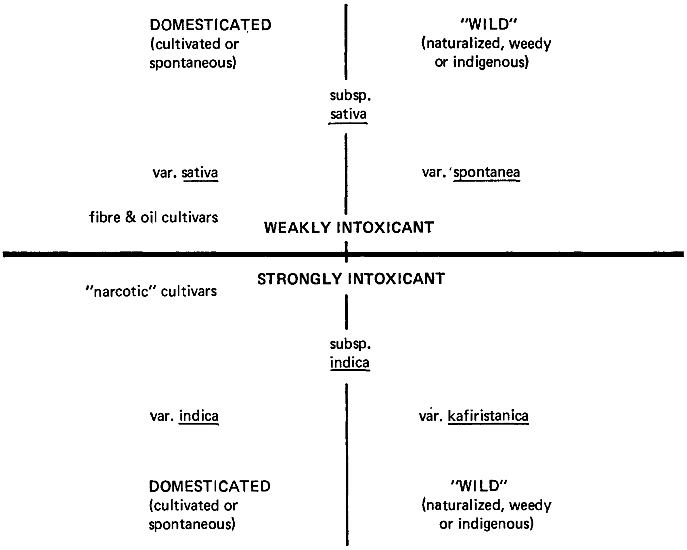


Fig. 6. Classification of *Cannabis sativa*, illustrating conceptual bases of delimitation.

We do not advocate the use of the "conspecies" (collective species – Bobrov, 1965) category as discussed by Zhukovsky (1967). We believe that the recognition of "species" within this category by Serebriakova and Sizov (1940; cf. Davidyan's comments on conspecies of *Cannabis*) and the general "degradation of rank" characterizing early Soviet plant taxonomy (cf. Bobrov, 1965 and Davis and Heywood, 1965), have led to fundamental misunderstanding during the forensic debate involving the taxonomy of *Cannabis*.

Formal Treatment

Our taxonomic treatment of *Cannabis* consists of a hierarchic recognition first of the two widespread groups based on agronomic properties, and second of a "wild" (sensu lato) and domesticated phase within each (Fig. 6). We could have inverted the hierarchy, and made the primary grouping on the basis of adaptation to growth in cultivation or in the wild, but we chose not to do so, for the reasons indicated below.

Genetic exchanges between cultivated and uncultivated populations occur wherever *Cannabis* has been cultivated for any considerable length of time. This interaction has been documented with regard to the fibre races and their wild (sensu stricto) or feral correlatives (e.g. Janischevsky, 1924; Vavilov, 1926; Scholz, 1957). Similar interchange between drug races and their wild or feral correlatives also appears to be extensive. On the other hand, such interaction between drug and fibre races is more restricted because of geographical separation, occurring chiefly where both sorts are (or have been) cultivated in proximity. Thus on the basis of the amount of genetic exchange, it seems advisable to make the primary infraspecific grouping in accord with what the plants have been cultivated for, and the secondary one in accord with whether the plants are adapted to growth in the wild or in cultivation. Fortunately, this arrangement is also in harmony with social needs and significance. The distinction between drug and fibre races is much the more important to society.

Distinction at the subspecific rank within *C. sativa* is carried out by chemical analysis, knowledge of geographical origin, and possible knowledge of agronomic use. Outside of smoking the material to evaluate its intoxicant level, which of course we cannot advocate, there is no simple means of ascertaining by intrinsic characteristics alone to which subspecies of *Cannabis* a given plant should be assigned. It will correctly be pointed out that the recognition of taxa based on such non-morphological diagnostic attributes represents somewhat of a departure from traditional plant taxonomy, and that informal treatment might be more in order. In defense of our treatment we must emphasize the special circumstances of *Cannabis,* a fundamentally cultivated plant, where the norms of traditional taxonomy require modified application. The distinction we are drawing is one which is based on the clear existence of two widespread (though not fully differentiated) kinds of plants that contrast in several non-morphological characteristics. The distinction is of fundamental economic significance to society, and has been inferred for centuries. Indeed some taxonomists today insist that these variants be recognized not merely as subspecies but as species. The further distinction we make into varieties on the basis of adaptation to growth in the wild or in cultivation is defensible on the same philosophical bases as those supporting the distinction of *Cannabis* into the subspecies we recognize, with the added feature that fairly clear morphological distinction is possible.

It will be appreciated that the four taxa we recognize coexist dynamically by means of continued natural and artificial selection. A given variant can conceivably migrate from any given group to any other with appropriate selection and alteration of genes controlling the critical diagnostic characteristics, and undoubtedly such exchanges have occurred and are occurring with some frequency. It is thus possible for there to be closer affinities between populations of different varieties than there is between populations of a given variety. The possibility of such parallelism or "convergence" connotes a measure of artificiality to our taxonomic scheme, but no more so, we believe, than is potentially applicable to all infraspecific taxonomic treatments (cf. Cronquist, 1968, pp. 13-19).

KEY TO SUBSPECIES AND VARIETIES OF *Cannabis sativa* L.[1]

1. Plants of limited intoxicant ability, Δ^9-THC comprising less than 0.3% (dry weight) of upper, younger leaves, and usually less than half of cannabinoids of resin. Plants cultivated for fibre or oil or growing wild in regions where such cultvation has occurred subsp. *sativa*
    2. Mature fruits relatively small, commonly less than 3.8 mm long, readily disarticu- without a basal constricted zone, not mottled or marbled, the perianth largely sloughed off var. *sativa*
    2. Mature fruits relatively small, commonly less than 3.8 mm long, readily disarticulating from the pedicel, with a more or less definite, short, constricted zone toward the base, tending to be mottled or marbled in appearance because of irregular pigmented areas of the largely persistent and adnate perianth var. *spontanea*
1. Plants of considerable intoxicant ability, Δ^9-THC comprising more than 0.3% (dry weight) of upper, younger leaves, and frequently more than half of cannabinoids of resin. Plants cultivated for intoxicant properties or growing wild in regions where such cultivation has occurred subsp. *indica*
    3. Mature fruits relatively large, seldom less than 3.8 mm long, tending to be persistent, without a basal constricted zone, not mottled or marbled, the perianth largely sloughed off var. *indica*
    3. Mature fruits relatively small, usually less than 3.8 mm long, readily disarticulating from the pedicel, with a more or less definite, short, constricted zone toward the base, tending to be mottled or marbled in appearance because of irregular pigmented areas of the largely persistent and adnate perianth var. *kafiristanica*

C. sativa L. Sp. pl.: 1027. 1753, subsp. *sativa*

Type specimen: Hortus siccus Cliffortianus p. 457 *Cannabis* no. 1, B (BM) lectotype by Stearn, Bot. Mus. Leafl. Harv. Univ. 23: 325-336. 1974. Fig. 7.

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[1] It must be emphasized that only substantially mature fruits exhibit the diagnostic characteristics clearly. Cautions regarding measurement of cannabinoids should also be borne in mind. Δ^9-THC concentrations are given for relatively mature plants.

Fig. 7. Type specimen of *C. sativa* L.

Diagnosis: Younger, upper leaves of relatively mature plants with less than 0.3% (dry weight) Δ^9-THC. Intoxicant cannabinoids generally comprising less than half of cannabinoids of resin. When dioecious, mature female plants generally with more than twice as much resin as mature male plants (on relative weight basis, comparing leaves and flowering parts excluding achenes).

Plants of *C. sativa* subsp. *sativa* have limited intoxicant potential. They are extremely common in North America, Europe, northern Asia, and infrequent elsewhere except where *Cannabis* has been cultivated for fibre or oil. Such plants are typically from areas north of latitude 30° N. (approximately), and when from such relatively northern areas, are usually phenologically adapted to relatively short periods of vegetative growth before short day length induces sexual maturity. Most monoecious races have been created by hemp breeders, but monoecious individuals sometimes also occur in normally dioecious races (see Holuby, 1878).

C. sativa subsp. *sativa* var. *sativa*

C. sativa (var.) *vulgaris* Alefeld, Landwirth. Fl. 288. 1816.

C. sativa f. *vulgaris* attrib. to Alefeld by Voss, Vilmorin's Blumengärtnerei, 912. 1896. (name not typified by Alefeld, but lectotypified, in effect, by Voss as *C. sativa* L.)

C. chinensis Delile, Ind. Sem. Hort. Bot. Monsp., published in Ann. Sci. Nat. Bot. 12: 366. 1849. *C. sativa δ chinensis* A. DC. *in* DC. Prodr. 16(1): 31. 1869. (Indicated by A. DC. to be a unit of less than varietal, perhaps subvarietal rank.) *C. sativa* C. [sic]*chinensis* Aschers. & Graeb. Syn. Mitteleurop. Fl. 4: 599. 1911. (Based on plants cultivated from seeds brought from China by Itier in 1846.)

C. gigantea Delile ex Vilmorin, Rev. Hort. 5: 109. 1851. (Based on plants cultivated from seeds brought from China by Hébert in 1846.)

C. sativa var. *gigantea* Alefeld, Landwirth. Fl. 288. 1866. (Not clearly typified, but possibly based on same type as *C. gigantea* Vilmorin.)

C. gigantea Crévost, Bull. Écon. Indochine n.s. 19: 613. 1917. Nom. nud.[2]

C. sativa β vulgaris A. DC. *in* DC. Prodr. 16(1): 31. 1869. (Indicated by author to be of less than varietal, perhaps sub-varietal rank.) *C. sativa* var. *vulgaris*, attributed to DC. by Korshinsky. Tent. Flor. Ross. Orient. 7(1): 392. 1898. (Not formally typified, but presumably intended to apply to *C. sativa* sens. strict.)

C. sativa γ pedemontana A. DC. *in* DC. Prodr. 16(1): 31. 1869. (Indicated by author to be a unit of less than varietal, perhaps sub-varietal rank, based on plants cultivated in northern Italy and southern France.)

C. sativa var. *culta* Czern. Consp. Pl. circa Charcoviam, 56. 1859. Nom. nud.

C. sativa subsp. *culta* Serebriakova; Serebriakova & Sizov *in* Vavilov (ed.) Fl. Cult. Pl. 5: 37. 1940. (Name intended to cover all cultivated forms of *C. sativa* L. as delimited by Serebriakova and Sizov, but not typified and not validly published, lacking a Latin diagnosis and lacking a reference to a previous diagnosis.)

C. sativa var. *praecox* Serebr. Trudy Prikl. Bot. 18(1): 410. 1928. Name not typified. Based on a dwarf (2-6 dm), early-flowering form of fibre hemp cultivated in northeastern U.S.S.R., especially in the province of Archangel.

C. sativa var. *monoica* Hol. Letop. Matice Slov. 1(43): 367. 1873. (Based on monoecious plants of Czechoslovakia; cf. Holuby, 1878.). The Holuby specimen from Slovakia at PRC that is labelled as the type of this variety was collected in 1882. It may serve to illustrate Holuby's concept, although we do not formally designate it as a lectotype.

C. generalis Krause *in* Sturm Fl. Deutsch. Ed. 2. 4: 199. 1905. (A superfluous untypified name, stated by the author to include *C. sativa* and *C. indica.*)

C. americana Houghton and Hamilton, Amer. J. Pharm. 80: 16. 1908. (Name not validly published; included here only because it has occasionally appeared in subsequent literature, e.g. C. F. W. Wehmer, Die Pflanzenstoffe, p. 248. 1911).

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[2] Several names that were not validly published have been included in the synonymy for the sake of clarity.

Diagnosis: mature fruits usually at least 3.8 mm in length, blunt at the base, tending to be somewhat persistent at maturity, the perianth adhering poorly and usually considerably sloughed off.

Plants of *C. sativa* var. *sativa* have been domesticated for fibre and/or oil. Fibre cultivars are usually taller than 3 m in hospitable circumstances (although a dwarf fibre variant was described by Serebriakova in 1928), and usually are characterized by long, more or less hollow internodes, and relatively sparse branching. The leaves are often larger than those of wild plants.

In addition to the cultivated plants, we include in this variety plants which have recently escaped from cultivation, and which therefore still substantially possess the attributes of domesticated plants.

Representative Specimens[3]

CANADA: Alberta: Spirit River, Peace River District, *Groh 972* (DAO). Ontario: Kingston, *Fowler* 8-IX-1897 (F, US); Ottawa, *Minshall* 19-IX-1938 (DAO); Ottawa, *Hopper* 26-IX-1912 (DAO); Brampton, *Lees* 12-IX-1889 (DAO); Galt, 23-VIII-1913 (DAO); Kitchener, *Hodgson* 19-VIII-1939 (DAO); near Newburg, *Mulligan & Dore 906* (DAO); Freenfield, *Kippen* VIII-1939 (DAO); Delaware, *Wood* 25-VIII-1932 (DAO); Timmins, *Dawson* 29-VII-1960 (DAO); Port Dover, *Cruise 10816* (DAO); Quebec: cultivated in Montreal Botanic Garden, *Rhodes 2528* (DAO); Hull, *Porrier* 24-VIII-1960 (DAO). U.S.A.: Colorado: Denver, *Bethel* IX-1916 (NY). Connecticut: New Haven, *Hawes* 2-IX-1874 (NY); Bridgeport, *Williams* 23-VII-1895 (GH); *Bissell* 19-VII-1905 (GH); Illinois: north of Pekin, *Chase* 13005 (DAO); Chicago, *Deane* 9-IX-1882 (GH); Tazewell Co., *Chase 6728* (NY); Oquawka, *Patterson*, accession 799439 (US). Indiana: Miller's *Umbach* 1-X-1898 (F, US), & 18-IX-1897 (F); Lake Chicago Basin, *Millspaugh 19* (F); near Centerton, *Friesner 11542* (F, NY). Kansas: Riley Co., *Norton 493* (GH, US); Whiskey Lake, Geary Co., *Gates 18701* (NY); Lawrence, *Horr E229.* Massachusetts: Chelsea, *Rich* 8-VIII-1897 (GH); Boston, *Boot* 24-VIII- 1853, 2 sheets (GH). Michigan: Port Huron, *Dodge* 23-VIII-1903 (US). Nebraska: SE Nebraska, *McFarland* VIII-1890 (F). New Mexico: cultivated, *Curtin* VIII-1930 (F). New York: Manhattan Island, VIII-IX-1879 (NY); Edwards, *Phelps 382* (GH); Vistal, Brome Co., *Millspaugh*, acquisition 19714 (F). Oregon: Salem, *Nelson* 1-IX-1917 (GH). Pennsylvania: Harrisburg, *J. K. Small* 11-VIII-1888 (F). Virginia: Shenandoah National Park. *Walker 3803* (US); Redford Co., *Curtiss* VIII-IX-1870 (GH). Washington: Ellensburg, *Whited 594* (US). West Virginia: N.E. West Virginia, *J. K. Small* 22-VIII-1890 (F). Wisconsin: Beloit, *Swezey* (LE); garden, Green Bay, *Schuette* 25-VIII-1878 (GH). U.S.S.R.: Kursk oblast, Kazatsky steppe, medvenka district, VIII-1936 (MW); hemp plantation, Irkutsk gubernia Verkhoyansky uyezd, Beryul'ka village, Siberia, *Aleksandrov 804* (LE); Schenzingea, Siberia, Herbarium Proprium Turczaninovii, 1849 (LE); garden, Shchuchinsky district, Tergol'skaye hamlet, *Ilyin & Prozorovsky 777* (LE); St. Petersburg, *Plikubarkin* (LE); near Lake Puskom, Vologodskaia county, *Zinzerling N248* (LE); Chenkurshkii, near Lipovskaia, Arkhangelskaia county, *Zinzerling & Serebriak 536g* (LE); cultivated, D. Buralikha, Plantae gub. Archangelsk et Vologda,

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[3] All representative specimens show sufficiently mature fruits to provide diagnostic characters. All sheets listed exhibit female or monoecious plants; some also show males. Chemical attributes of borrowed herbarium specimens are deduced from their geographical origin. Additional specimens of the taxa proposed here are cited in Small et al., 1976, with a complete set of vouchers at DAO, and duplicates of most acquisitions at BM, US and NY. In Small et al., 1976, the 88 fibre cultigens cited are referable to var. *sativa*; included in var. *kafiristanica* are populations 163, 165, 166, 167 and 194 (India), 70 (Mauritius), 76 (Uganda); included in var. *spontanea* are 82 (U.S.S.R.), 9, 20, 30, 31, and 189 (Canada), 184 (Hungary), 28 (Germany), 243 (Poland), 25, 79, 297 (U.S.A.); included in var. *indica* are 154 (Cambodia), 186 (Gambia), 26, 164 (India), 66 (Jamaica), 300, 301 (Malawi), 41, 284 (Mexico), 235 (Rhodesia), 63 (Sierra Leone), 11, 74, 162, 273 (South Africa), 10 (Thailand), 77 (Uganda).

Zinzerling 6 (LE); Plantae gub. Archangelsk et Vologda, *Zinzerling 10* (LE); cultivated "Japanese hemp", Kazakstan, Almaatinsk, *Chernikovskaia A42* (Wa, LE); near Batalpashinska, near River Abozinki, Armavirskii county, *Nenivkova 244* (LE); Lake Segozer, *Iljin 874* (LE); Orenburg region, *Fedchenki & Borisova 1247* (LE); Irkutsk region, Tugutuisk, Siberia, *Belousov* (LE); Plantae gub. Enisseisk, Usinskii region, Uriankhaiska steppe, Siberia, *Schulga* 1907 (LE); Tomskii region, locale Mariinsk, Siberia, *Kutscherovskaja* 1912 (LE); Vladimirovska, far-eastern region, Khabarovskii Okrug, Siberia, *Solokhin* (LE); Kiev region, Ukraine, *Pidokyuchko* 27-VI-1923 (DAO); Vashkiria, b. Ufimsk, *Noskov*, 2 sheets, (MW); cultivated in Ottawa from seeds from Kaunas Univ. Bot. Gdn., Lithuania, *Zinck* 40-97-158 (DAO); Plantae gubernii Wladimiriensis, *Nasarov 774* (MW); Moscow, *Maksimovich 483* (MW). CZECHOSLOVAKIA: Slovakia, *Holuby* VII-1882, Typus 215 (PRC); Trencin, Nové Podhradie, "Hungary", *Holuby* 24-VII-1878, acquisition 9481 (W); Bohemia, *Maloch* 4-VIII-1909 (PRC); Moravia, *Bubela* IX-1879 (PRC); Bohemia, *Obdrazalek* 12-VII-1908 (PRC); Slovakia, *Mikulas* VII-1932 (PRC); Bohemia, *Fleischer* 28-IX-1908 (PRC), & 25-IX-1910 (PRC, US, W). AUSTRIA: Augarten, *Makowsky W56* (W); *Prerovsky* 7-VIII-1872 (DAO); acquisition 9478 (W); Herb. K. Ronniger, acquisition 22266 (W); Herb. E. Rainer, acquisition 20891 (W). POLAND: Gostynin region, VII-1926, acquisition 048665 (WA); Flora Silesiaca, Bieslen, outside of Aedlitz, *Schube* 15-X-1895 (WRSL); Bodzentyn, Gouv. Kielce, *Puring* VII-1897 (LE); Lipnowskie, Cisowski (WA); Zloty Potok, *Krak-Wlekunska & Radwanska* 22-VIII (WA); Zloty Potok, VIII-1922 (WA); Grocholice, *Kobendza* VIII (WA); Pokozywianka, accession 048677 (WA); Pokozywianka, accession 048675 (WA); Univ. Mississippi plantation, Quimby acquisition code Cz A, *Schultes, Plowman & Lockwood 96* (DAO, ECON); Univ. Mississippi plantation, Quimby acquisition code Cz B, *Schultes, Plowman & Lockwood 97* (DAO, ECON). FRANCE: Univ. Mississippi plantation, Quimby acquisition code Fr. A, *Schultes, Plowman & Lockwood 92* (DAO, ECON); Quimby Fr C, *Schultes, Plowman & Lockwood 93* (DAO, ECON); Quimby FR B, *Schultes, Plowman & Lockwood 94* (DAO, ECON); Quimby Fr E, *Schultes, Plowman & Lockwood 95* (DAO, ECON); Rouen, *Tidestrom 13422* (NY). SWITZERLAND: Fribourg, *Castella* 30-VII-1904 (US). CHINA: Kwangsi, *Ko 56012* (GH). Kweichow, *Tsiang 7431* (BM, NY, US); Kweichow, *Ching & Merrill 90560* (K); Kweichow, *Tsiang 9255* (W); Kweichow, Anhwei Province, *Ching 9060* (US); Western Hupeh, *Wilson 428* (GH, K, US, W); Western Szechuan, *Wilson 4401* (GH, K); Kangtin Hsien, Tachienlu, Szechuan, *Fang 3525* (GH, US); Tsinanfu, Shantung Province, *Chiao 3165* (F, GH, NY); Univ. Mississippi plantation, Manchuria, Quimby acquisition code Mn A. *Schultes, Plowman & Lockwood 79* (DAO, ECON); Chinchou, near Dairen, southern Manchuria, *Dorsett & Morse 5857* (US). JAPAN: Herb. Savatier, accession H1153/70 43 (K); Kanazawa-Zushi, Sagani, *Maekawa 4202* (TI); Honshu, Pref. Okayama: Fukutamimura, Kibi-gun, *Nikai* 24 IX-1903 (TNS). KOREA: *Smith* 1-X-1937 (GH). MONGOLIA: Honger Obbo, *Eriksson* 22-VIII-1928 (US). TURKEY: Univ. Mississippi plantation, Quimby acquisition code T A, *Schultes, Plowman & Lockwood 63* (DAO, ECON).

C. sativa subsp. *sativa* var. *spontanea* Vavilov

C. sativa var. *spontanea* Vavilov, Trudy Prikl. Bot. Selekc. 13 (suppl. 23) 148. 1922.

Type specimen: Antropova 121, plants grown in 1925 at the Kamenna experiment Station from seeds collected near Saratov in 1921; lectotype here designated, at WIR.[4] Fig. 8.

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[4] There is a problem with typification of Vavilov's names, since he characteristically collected seeds or fruits, rather than making herbarium specimens. It may seem irregular to typify a name on a specimen that did not exist until after the name was published, but we believe that the circumstances in this instance justify such a procedure. We find no pre-1922 specimen at the Vavilov Institute (WIR) that could serve as a type. In the 1922 publication, Vavilov specifically referred to the work of his colleague Antropova, and Saratov was the first locality he mentioned.

Fig. 8. Type specimen of *C. sativa* L. subsp. *sativa* var. *spontanea* Vavilov.

C. sativa var. *spontanea* Czernj. Consp. Plant. circa Charcoviam 56. 1859. (Nom. nud., not validly published).

C. sativa subsp. *spontanea* Serebriakova; Serebriakova & Sizov *in* Vavilov (ed.) Fl. Cult. Pl. 5: 40. 1940. (Name not validly published, lacking Latin and lacking a reference to a previous description. Untypified, but intended to apply to wild-growing forms of *C. sativa* as defined by the authors.)

C. ruderalis Janischevsky and *C. sativa* var. *ruderalis* Janischevsky (alternative names) Uchen. Zapiski Univ. Saratov 2(2): 14. 1924. (*Janischevsky s.n.*, near Saratov, U.S.S.R., in 1920, LE = lectotype.)

Diagnosis: mature fruits usually shorter than 3.8 mm, with persistent mottled perianth and constricted base, readily disarticulating from the plant at maturity.

This taxon includes indigenous or well-established weedy or naturalized plants which are either substantially unmodified by domestication represent biotypes which have undergone considerable de-domestication. This group is highly variable vegetatively, and is common where *Cannabis* has been cultivated and/or domesticated for fibre and/or oil properties, notably in North America, Europe, and northern Asia.

Davidyan (1972, p. 25) states that I. Nikiforov in 1932 assigned the wild hemp he found in Kurdistan to *C. ruderalis* Janisch var. *transcaucasica* Nikiforov. It appears, however, that Nikiforov never published this name. *C. sativa* subsp. *sativa* and subsp. *indica* can be expected to intergrade in Kurdistan, and wild plants of this region, and of other such geographically intermediate areas, intergrade between var. *spontanea* and var. *kafiristanica*.

Representative Specimens

CANADA: *Quebec*: Harnam's Corners, *Edmondson 5234* (NY); Hull, *Dore & Erskine 14107* (DAO); Hull, *Macoun* VIII-1911 (F); Indian Lorette, *Pease 6333* (GH); St. Jerome, *Groh* 1-IX-1939 (DAO), & 1-IX-1939 (DAO); Trois Rivières, *Mulligan 626* (DAO), Montreal, *Roy 4121* (DAO); Laprairie, *Cléonique 9064* (DAO); Baie St. Paul, *Anderson 1214* (DAO). Ontario: Ottawa, *Macoun* 6-VIII-1894 (GH); Ottawa, *Macoun* 1-IX-1898 (DAO); North Lancaster, *Anderson 593* (DAO); Selby, *Lethbridge* 20-VII-1961 (DAO); Cherry Valley, *Grainge* 22-VII-1962 (DAO); Glengarry Co., *Langton* IX-1938 (DAO); Picton, *Muir* 14-IX-1960 (DAO), & 16-VII-1960 (DAO); Eastview, *Porrier* 24-VII-1960 (DAO). U.S.A.: Illinois: Ravenswood, *Lloyd* 15-IX-1887 (F); near Rockton, *Chase 10935* (F); Kickapoo Valley, Peoria Co., *Chase 3405* (F, NY); near Nahomet, Champaign Co., *Jones 13082* (NY); or Hedgerow, Champaign Co., *Pease 13053* (GH); Chicago, *Bennett* 2-IX-1957 (F, W). Iowa: Kalsow Prairie, *Brotherson 1384* (NY). Massachusetts: Dorchester, *Linhthipe* 1-X-1891 (NY). Missouri: near Bluffport, *Steyermark 26408* (F); Hannibal, *Davis 6055* (DAO); near Columbia, *Dunn 12721* (NY). Wisconsin: Kettle Moraine State Forest, *Bartlett & Richards 1118* (DAO). U.S.S.R.: *Czernjaevi* 29-VIII-1864 (CWU); Shtaf, region of Saratov, *Janischevsky* 1-VII-1924 (LE); northern outskirts of Lake Kzyl-Tau, vicinity of Lake Inder, *Janischevsky* 28-VII-1929 (LE); Semirechiye, Kurgan uyezd, above floodplain of Koktal, *Bykov 142* (MW); Stalingrad oblast, Krasnoarmeisky district, Dubovyi Ovrag hamlet, *Kaden 466* (MW); Voronezh oblast, Novokhopersk district, shore of Lake Chiganok, *Krasovskaya 547* (MW); Ukraine, Jarkovo uyezd, *Titov 432* (MW); slopes of cape at Nikol'sky elevation in Tobolsk, Siberia, *Mamayer 333* (LE); Zabaikal oblast, Aginsk steppe, Siberia, *Chudnovsky* 1911 (LE); *Becker* 1851 (LE); Semipalatinsk oblast, Zaisan uyezd, Zaisan steppe, *Ryznichenko 426* (LE); Khanbulinsky state farm, Bashkir Republic, *Geirikhson & Ivanova 2109* (LE); Razdel'naya station on SW Raikoky, 20-VII-1937 (MW); Azerbaidzhan Zakavkaze, 28-X-31 (LE); Ural River, Kandavrovskoi Station, *Dubianskii* 7-IX-1922 (LE); Str-Darvinsk, vicinity Kara-kum, *Sovytkina & Chavsova 978* (LE); Semipalatin, *Korzhinskii* 4-VIII-1890 (LE); Balkhach-Alakolskaia nizmennost, *Linchevskii & Linchevskii 221* (LE); Waranesh region, *Cand-Muller 1867* (LE); delta of Volga River, Astrakhanskaia region, *Tselev & Koleshikova 708* (LE); Muraptalovsk collective farm, Sterlitamaksii canton, Plantae Baschkiricae, *Shtukenberg 1807* (LE); near Churan River, Orenburg region, *Sukhova 459* (LE); Orenburg region, *Rozhanets-Kucherovskaia* 7-VIII-1927 (LE); near Alma-Ata, Kzakstan, *Dubiansky & Basilevskaja* 18-VII-1927 (LE); Obere Boratala, Turkestan, *Regel* 4-VIII-1878 (LE); Verkh-Atashevoi, Plantae Baschkiricae, *Kucherovskaia & Antonova 310* (LE); SE of Abrakham, *Podzner* 31-X-1968 (LE); vicinity of Orenburg, confluence of rivers Bolshoi & Malyichuran, *Sukhova 450* (LE); Okrecshnosti Saratova, *Janischevsky*, 1920 (LE); Novosibirsk region, Siberia, *Bagirda* 13-VII-1956 (LE); Zabaikalsk, Siberia, *Kuvaev 281-4* (LE); Zabaikalsk, Barguzina river basin, Siberia, *Zhukova 528* (LE); near Ivanovsky, Buriato-Mongolskia, Kudar River basin, ASSR, Siberia, *Kurshkii* 6-VIII-1934 (LE); Iakutskaia Republic, Siberia, *Drabov & Tarabukin 1436* (LE); steppe along rivers Uruliuguiu &

Argun, Station Matsshvksaia, Siberia, *Ivanova 401* (LE); Zabaikalsk, Siberia, *Stunov 42* (LE); Altai Oirotskaia avt. obl. Okr. s. Inia, Siberia, *Shteinberg* 13-VIII-1931 (LE); Altai Biiskii near Chuisk, Trakt, Siberia, *Klements 523* (LE); Mivn-Kum, *Butriakov 592* (GH); Plantae Kasakstanicae, gub. Dschetysu distr. Taldy-Kurgan, river Karatal, *Smirnov 137* (MW), *919* (MW), *922* (MW), *1025* (MW); Przheval'sk, *Gubanov* 20-VII-1956 (MW); Ketnienskii Khrehet, near Berlik-Sushie River, *Rodin 1299* (MW); Voisko-Donskii region, *Kramsakov 1876-88* (MW); Dzhungariia, municipality Kul'dzhi, *Larionov 65* (MW); Alma-Ata region, bank of Kaskelenki River, *Pavlov* 5-IX-1942 (MW); Talasskii Alatau, municipality of S. Dimitrievki, *Iljin 288* (MW); Log Tyrakllycai, *Cherniakowska 233* (WA); Bien-Aksuisk region, *Smirnov 582* (GH); Kiev, Ukraine, *Lonashevskii*, 1937 (DAO); Terskei Alatau, *Medvedeva et al. 881* (BM); West Kazakstan, Chingirlatskii region, *Paliakova N69* (BM); Cherkasskii region, St. Persianovka, south of Rechianovka, *Poliakova 86* (NY); Dagestan, regione Khassavjurtov, *Nekrassova 268* (NY); West Kazakstan region, *Rodin & Smirnov 87* (US). CZECHOSLOVAKIA: Bratislava, Slovakia, *Dlabacova* 24-VI-1934. (PRC); Slovenica, *Domin* VII-1929 (PRC); *Holuby* 11-IX-1911 (PRC). GERMANY: Karlsburg, accession 9477 (1966) (W). AUSTRIA: acquisition 4490 (W); Herb. J. Schneider, acquisitions *494* (W), *495* (W), Steirmark, Graz, *Höpflinger* 20-IX-1947 (W); between Grammat-Neusiedel & Mariental, Niederoesterreich, *Korb* 20-VIII-1917 (W); Niederoesterreich, Marchfeld, *Korb* 29-VIII-1922 (W). POLAND: near Czestochowy, *Karo* VIII-1880 (WRSL); Warszawa-Mokotow, *Zanowa* 1959 (DAO); Praga, *Muszynski* IX-1902 (WA); between Myslenrinck and Rinkan, *Bromberg* 29-VII-1892 (WRSL). MONGOLIA: Tsentsen-Khan, Deniganja & Mergenven Khoshuns, *Zamatkinov 103/11* (NY); Uriankha iskaia Zemlia, *Nesterov* 29-VII-1907 (LE).

Specimens which are more or less intermediate between C. *sativa* var. *sativa* and C. *sativa* var. *spontanea* are encountered frequently. Such specimens are especially common in the United States at present, where *Cannabis* was widely cultivated up to and including the early part of this century, with renewed cultivation stimulated by fibre shortage during the Second World War. It is possible that widespread escape from cultivation during the second World War occurred, and so much of the spontaneous *Cannabis* population of the United States is currently undergoing de-domestication, and re-acquiring the fruit characteristics of wild plants (cf. Small, 1975a). Sojak (1960) described such intermediate plants as *C. intersita* hybr. n. (= C. *ruderalis* Janisch. X C. *sativa* L.; cf. Lonachevsky and Kotov 1952, p. 160.)

Representative Specimens Intermediate between Vars. sativa and spontanea

CANADA: Quebec: Longueuil, *Marie-Victorin & Rolland-Germain 713* (DAO). Ontario: *Macoun 1299* (K); near Brantford, RCMP 2-X-1968 (DAO); Point Abino, *Pollard* 28-VIII-1896 (US). U.S.A.: Illinois: Chicago, *Chase 1191* (NY); Edgewater, Chicago, *Chase* 28-IX-1896 (F). Indiana: Lake Maxinkuckee, *Churchill* 24-VIII-1926 (GH). Iowa: Ames, *Pammel & Combs 185* (F, K, NY, US). Minnesota: Fort Swelling, *Mearns 603* (NY, US). Missouri: Singleton Lake, *Metcalf 1014* (US). Nebraska: Fremont, *Kiener 21503* (F, W). New York: Kelloggsville, *Kilbourne* 28-VIII-1882 (W); Ithaca, *Coville* 23-VIII-1883 (US). North Dakota: Colfax, acquisition 2004212 (US). Pennsylvania: Easton, *Porter* VIII-1886 (US). Rhode Island: Providence, *Collins* 9-VI-1901 (GH). South Dakota: Black Hills, *Forwood 337* (US). U.S.S.R.: Flora Moldavii, along Sarata-Gaibena River, *Andreev W82* (LE). GERMANY: Kulm, *Ahlvengren* 5-VII-1901 (W.) JAPAN: Musashi, Meguro, Tokyo, Meguro Ward, *Tomitaro* 19-X-1922 (MAK).

C. *sativa* subsp. *indica* (Lam.) Small & Cronq., comb. nov.
C. *indica* Lam. Dict. Encyclop. Bot. 1(2): 695. 1785.

Type specimen: "Chanvre rapporte de l'Inde par M. Sonnerat". Herb. Lamarck (P). Fig. 9. The holotype is the uppermost 3 dm of a pistillate plant in flower, with conspicuous, exserted styles. Although it lacks fruit, it is here considered, on the basis of Lamarck's comments, to represent a domesticated plant.

Fig. 9. Type specimen of *C. indica* Lam. (*C. sativa* subsp. *indica* (Lam.) Small & Cronq.)

Diagnosis: Younger, upper leaves of relatively mature plants with more than 0.3% (dry weight) Δ^9-THC. Intoxicant cannabinoids frequently comprising more than half of cannabinoids of resin. When dioecious, mature female plants with less than twice as much resin as mature male plants (on relative weight basis, comparing leaves and flowering parts, excluding achenes).

Plants of *C. sativa* subsp. *indica* have considerable intoxicant potential. Plants of this taxon are typically from areas south of latitude 30° N. (approximately), and are extremely common in southern Asia, Africa, frequent in central and South America, and relatively infrequent elsewhere. They are phenologically adapted to a relatively long period of vegetative growth before short day-length induces sexual maturity.

C. sativa subsp. *indica* var. *indica* (Lam.) Wehmer[5] Die Pflanzenstoffe. 248. 1911.

C. sativa var. *indica* Pers. Syn. Plant. 2: 618. 1807. Nom. nud., not published with any indication of being based on Lamarck's *indica.*

C. macrosperma Stokes, Bot. Mat. Med. 4: 539. 1812. *C. sativa* B. *macrosperma* Aschers. & Graeb. Syn. Mitteleurop. Fl. 4: 599. 1911. (Typification recondite, but the name as used by Stokes obviously intended to apply to southern Asiatic drug plants. Ascherson and Graebner had a different concept, but based their varietal combination on *C. macrosperma* Stokes.)

C. sativa α kif A. DC. *in* DC. Prod. 16(1): 30-31. 1869. (Name indicated by A. DC. to be of less than varietal, perhaps subvarietal rank; cultivated material from Algeria & Tunis.)

C. sativa forma *afghanica* Vavilov Bull. Appl. Bot. Gen. Pl. Breed. 16(2): 227. 1926. *C. indica* var. *kafiristanica* forma *afghanica* Vavilov *in* Vavilov & Bukinich, Zemled. Afghan. 381. 1929. (Kunar River, Afghanistan, between Chekosarai and Jalalabad; no specimens found at Vavilov Institute, Leningrad. Transitional toward var. *kafiristanica.*)

Diagnosis: mature fruits usually at least 3.8 mm in length, blunt at the base, tending to be persistent at maturity; perianth adhering poorly and usually considerably sloughed off.

Plants of this variety have been domesticated for intoxicant properties. They are highly variable vegetatively, but are often shorter than 3 m even in hospitable environments, often much-branched, often have short internodes, and often have relatively solid stems in the internodes. They are common in southern Asia, and are locally grown elsewhere for the narcotics trade.

In addition to the domesticated plants, we include in this variety plants which have recently escaped from cultivation, and which therefore still substantially possess the attributes of domesticated plants.

Representative Specimens

AFGHANISTAN: Kandahar, *Schultes 26503* (DAO, ECON), *26504* (DAO, ECON), *26508* (DAO, ECON); Univ. Mississippi plantation, Quimby acquisition code Af A, *Schultes, Plowman & Lockwood 52* (DAO, ECON), Quimby Af B, *Schultes, Plowman & Lockwood 53* (DAO, ECON); drug seizure, cultivated at Ottawa as *E. Small pop. 396* (DAO); drug seizure, cultivated at Ottawa as *E. Small pop. 403* (DAO); *Khost 1068* (W). PAKISTAN: Yarkhuntal, Chitral, *Stamm & Wöhrl 157* (W); Univ. Mississippi plantation, Quimby acquisition code P A, *Schultes, Plowman & Lockwood 56* (DAO, ECON). INDIA: Nowgong Thana, Rajshahye district, Dinagepur district, & Bogra district (3 collections on sheet), *D.P.* 10-IV-1890 (CAL); Khandua, Hemp Drugs Commission, 28-X-1893 (7 sheets) (CAL); Bengal, *Clarke 31889* (BM); *Prain*, 1-III-1893

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[5] Although we have sifted considerable literature, we are unable to find an earlier validation of this combination than Wehmer (1911). However there is frequent earlier informal reference to "indica" as a variety, and it is not improbable that the combination was validly published earlier.

(CAL), 9-III-1893 (CAL); near Srinagar, Kashmir, X-1856, acquisition 4539 (LE). CAMEROON: drug seizure, cultivated at Ottawa as *E. Small pop. 393* (DAO). TANZANIA: drug seizure, cultivated at Ottawa as *E. Small pop. 394* (DAO) GHANA: drug seizure, cultivated at Ottawa as *E. Small pop. 395* (DAO). UGANDA: drug seizure, cultivated at Ottawa as *E. Small pop. 400* (DAO). MALAWI: *Phipps 783* (K). *TAN*-GANYIKA: *Davies D. 569 (*K). ETHIOPIA: Harar, accession H1153/70 *26* (K); drug seizure, cultivated at Ottawa as *E. Small pop. 398* (DAO). RHODESIA: northern Rhodesia, *Fanshawe F.4364* (K); southern Rhodesia, *Arnold 7994* (K). SIERRA LEONE: Univ. Mississippi plantation, Quimby acquisition code S1 A, *Schultes, Plowman & Lockwood 69* (DAO, ECON). MOROCCO: Univ. Mississippi plantation, Quimby acquisition code Mo B, *Schultes, Plowman & Lockwood 71* (DAO, ECON). SOUTH AFRICA: Univ. Mississippi plantation, Quimby acquisition code A A, *Schultes, Plowman & Lockwood 50* (DAO, ECON); drug seizure, cultivated at Ottawa as *E. Small pop. 397* (DAO). ANGOLA: Huila, *Powell-Cotton 510* (BM). THAILAND: Khirioong, *Suvarnakoset 213* (TNS); Univ. Mississippi plantation, Quimby acquisition code Ti C, *Schultes, Plowman & Lockwood 88* (DAO, ECON). LEBANON: Hamouneh, accession H1153/70 37 (K). IRAQ: accession H1153/70 40 (K). U.S.A.: Jailyard, Bluffton, Indiana, acquisition 782745 (F). MEXICO: *Lumholtz* VIII-1896 (US); Univ. Mississippi plantation, Quimby acquisition code MA (3), *Schultes, Plowman & Lockwood 64* (DAO, ECON).

C. sativa subsp. **indica** var. **kafiristanica** (Vavilov) Small & Cronquist, comb. nov.

C. indica Lam. var. *kafiristanica* Vavilov *in* Vavilov & Bukinich, Zemled. Afghan. 381. 1929

Type specimen: Vavilov Inst. Herb. # 3952, from seeds sown in 1927 of *Vavilov 599*, Chekhosara, Afghanistan; a very young plant, illustrated by a half-tone in the original publication; lectotype here designated, at WIR. Fig. 10.

Diagnosis: mature fruits usually shorter than 3.8 mm, with persistent mottled perianth and constricted base, readily disarticulating from plants at maturity.

This taxon includes indigenous, or well-established weedy and naturalized plants, which are either substantially unmodified by domestication or have undergone considerable de-domestication. They are highly variable vegetatively, and are common where *Cannabis* has been cultivated and/or domesticated for intoxicant properties, notably in southern Asia, and Africa, and to a limited extent in Mexico, and central and South America. THC content tends to be lower than in *C. sativa* var. *indica* (e.g. Krishnamurty and Kaushal, 1974), likely reflecting relaxation for intoxicant ability.

Representative Specimens

AFGHANISTAN: Kafiristan, *Vavilov 5667* (LE); Nuristan, *Street* 235 (F); Nuristan, Kamdesh, *Street 226, 226A* (F); *Griffith 4686* (K). INDIA: Punjab, Bashahr State, N.W. India, *Koelz 7264* (US); Bengal, accession 802823 (US). Shanglikund, Almora, *G.G.S. 52469* (LWU); Simla, Gopalpur, *Dogra 83403* (LWU); Simla, *Kaul 61996* (LWU); *Fuller 36137* (CAL; Nirza, Chitral, *Gatacre 17358* (CAL); *G. Thomson*, accession 42388 (CAL); accession 423354 (CAL, LE); Sikkim Himalaya, *Gammie*, accession 423328 (CAL); Garhval Province, western Himalaya, *Tehlaginett 8457* (GH); Pathankot, Punjab, *Koelz 10365* (GH); Sikkim, *Cave 655* (BM); Tehri-Garhwal, *Huggins TY4* (BM); accession 423357 (CAL); Himal. Bor. Occ., *Hook & Thomson* (GH); Simla, accession H1153/70 63 (K); Dehra Dun, *Singh 48* (NY); Keshapur, Punjab, *Koelz 1666* (NY); East Bengal, East India Co. acquisition no. 4686 (GH); Sabjikalra, Murshidabad, Bengal, *Buha Baleshi 246* (MAK). NEPAL: East Nepal, Dhankuta-Hilay, *Hara et al.*, 23-X-1963 (TI); Univ. Mississippi plantation, Quimby acquisition code Ne B, *Schultes, Plowman & Lockwood 58* (DAO, ECON). CHINA: Yunnan province, *Wang 69367* (GH), *70262* (GH); Makeng River, Chiapieh, Yunnan Province, *Yu 7817* (GH). SOUTH AFRICA: Pretoria, *Codd 8506* (K). COLOMBIA: Region de Urrao, acquisition 1007144 (F).

Fig. 10. Type specimen of *C. sativa* subsp. *indica* (Lam.) Small & Cronquist var. *kafiristanica* Vavilov.

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