

CANNABIS: AN EXAMPLE OF TAXONOMIC NEGLECT

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The story of marijuana
is not yet written.

—H. H. Nowliss

I

It is often true that we know less about the classification of our widely cultivated plants than we do about some of the rare wild species of limited or endemic distribution. The cultivation and dispersal of a domesticated plant tend to alter the organism in many ways, often so drastically that it may be difficult or even impossible to point to a wild species as its progenitor. Sometimes the plant is so dramatically changed that it becomes wholly dependent on man for its survival (21).

The genus *Cannabis* provides an excellent example of an important group of useful plants the classification of which has long been clouded in uncertainty. One of man's oldest domesticates, dating back nearly to the beginnings of agriculture, *Cannabis* as we now know it has developed together with man as a multi-purpose economic plant:

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the source of a fibre, a narcotic, a medicine, an oil, and an edible fruit (2, 7, 13, 19, 20).

Native apparently somewhere in central Asia, where it occurs as a plant of open, disturbed habitats, such as riverbanks, bottomlands, and hillsides, hemp has spread to all parts of the world where conditions are suitable for its growth: in fact, it is at present one of the most widely disseminated cultivated plants (4, 18, 29, 31).

The effects of man's subconscious and later conscious selection for desirable characteristics combined with the effects of natural selection under the stress of new and sometimes inhospitable environments have acted significantly in morphologically and perhaps chemically altering the *Cannabis* plant. As a result, today, possibly some 10,000 years after the beginnings of the man-hemp partnership, *Cannabis* has become one of the most variable of cultivated plants.

It is precisely this variability and our lack of anything approaching a full understanding of its nature and extent that have created a most difficult problem for systematists who have attempted to delimit specific and sub-specific boundaries in the genus.

Unlike some domesticated plants, *Cannabis* is believed still to occur in wild populations in certain parts of Asia and to exhibit in these populations an appreciable amount of inherent natural variability (5, 29). Man took advantage of this variability as he domesticated *Cannabis* by cultivating and artificially selecting for a number of useful traits, such as elongated bast fibres, large seeds with high oil content and copious production of narcotic resin. Under the pressures of selection for these characters, *Cannabis* began to reveal characters and combinations of characters not found in wild or presumed wild populations, a phenomenon that has occurred in every plant domesticated by man.

Unlike many of man's other cultivated plants, however, hemp never became totally dependent on man. In many areas where hemp was cultivated, it readily escaped and became naturalized as an aggressive weed. Thus released from the pressures of artificial selection induced by cultivation, populations of naturalized Cannabis underwent extensive adaptive radiation.

In this new role, Cannabis invaded many disturbed habitats, especially habitats newly created by man, becoming established and spreading without man's direct intervention. Like many other weeds, hemp became one of man's camp followers along roadsides and in rubbish heaps and growing on the edges of fields (1, 2, 3, 29). The changes invoked by the transition from domestication to naturalization included, at least in some cases, reversions to characteristics peculiar to wild hemp, as has been known to occur in other cultivated plants.

We thus perceive three "phases" of Cannabis—the wild, the cultivated, the weedy. These "phases" are not necessarily three discreet states of existence. The last two "phases", occurring over vast areas of the world and under highly varied ecological conditions, have created the great array of phenotypic diversity which we witness today in cultivated and naturalized hemp. Cannabis in the wild state has probably adapted well to disturbed conditions. Its wild adaptive mode pre-adapted it in many cases to certain cultivated conditions and often made an easy transition back to the weedy state or "phase" (4, 19, 20, 29, 30).

As a result of the extraordinary plasticity and variability evident in present-day cultivated and weedy Cannabis, there can be no hope of unravelling the complexities encountered in the genus through a study of cultivated types alone. No certain progress can be effected, until the biology of wild or presumably wild populations

are carefully investigated—and it must constantly be borne in mind that there can be no *wild* hemp except in areas where it is native. The most critical studies on cultivated or weedy types of *Cannabis*—in Europe, North America and South America, for example—can yield little new evidence towards an understanding of the species composition of the genus. There have been enough examples of cultivated plants the classification of which has been clarified as a result of an investigation of wild ancestral types, of wild populations or of related wild species to indicate the desirability and necessity of this approach in the case of *Cannabis*.

II

Although the taxonomic literature on *Cannabis* is complicated by a confusing plethora of specific and varietal names (most of which have never been properly published or described, according to the rules of botanical nomenclature), the genus has been and still is generally considered to be monotypic.

We are persuaded that this opinion is the result of an almost total lack of taxonomic investigation of wild *Cannabis* as it occurs in its natural habitat or even of comprehensive and comparative studies of the range of variation found in cultivated hemp. Since botanists have not carried out such detailed and critical taxonomic studies, it has naturally been customary for authors of text-books, check-lists, floras, manuals, botanical dictionaries, pharmaceutical publications, agricultural treatises and other generalized and summary-type publications to repeat the orthodox monotypic concept, thus establishing it even more firmly in the literature. This establishment of the monotypic concept is reflected in modern chemical publications and even in the drafting of laws in some of the countries that control the use of *Cannabis*.

A polytypic concept of the genus is not new. It goes

back 190 years to Lamarck's recognition of a collection from India as distinct from the species which Linnaeus thirty years earlier had named *Cannabis sativa*.

As an outcome of investigations carried out by Russian students of crop plant evolution in the 1920's and 1930's, the opinion that there are indeed several species of Cannabis was, for the first time, offered on the basis of studies and experience in the field. They are the only taxonomists to have studied extensively wild populations of Cannabis. Their work, however, has not been widely accepted. Failure to accept or at least to consider seriously their opinions has been the result of several factors: partly because their work was published in Russian in journals of limited availability; partly because western botanists were not able to visit the areas of presumed wild Cannabis in Russian territory; and perhaps most significantly because of conservative unwillingness to contemplate change in the established belief in the monotypic nature of the genus.

We began to question the generally accepted view of Cannabis as a monotypic genus in 1969, when one of the writers (Schultes) was invited to address a symposium in London composed mainly of chemists and pharmacologists. He was asked to address himself to what is *not* known about the botany of Cannabis. Although, in that lecture, essentially a review of the literature, he clung to the idea of the monotypic nature of the genus, his evaluation of the limited taxonomic studies raised serious doubts in his mind about the propriety of this viewpoint (19). Subsequent critical studies of the literature; examination of material from many areas preserved in several of the world's largest herbaria; preliminary field work in Afghanistan; and a survey of the plantings of Cannabis in Mississippi from seed imported from many localities around the world under the auspices of the National Institutes of Health—all have combined to convince us

that *Cannabis* is not monotypic and that the Russian concept that there are several species may be acceptable.

It is not only the Russian sources (10, 29, 30, 31) that accept the polytypic concept of *Cannabis*. The British taxonomists who are editing *Flora Europaea* (28) clearly indicate their belief that two species occur within the confines of the floristic area which they consider Europe. Although they have not published their opinions, several American taxonomists who have examined the evidence likewise favor the polytypic concept.

Other botanists who still maintain the monotypic nature of *Cannabis* are receptive to the possibility that continued study may indicate more than one species. After a careful taxonomic evaluation of *Cannabis* on a generic basis, for example, Miller (14) suggested that only additional investigations could clarify the variability in characters on which several species have been set up. And Small (22), who has carried out extensive cytological research on *Cannabis*, has stated that . . . "there would not appear to be a basis for recognizing species or other taxonomic groupings in *Cannabis* on the criterion of breeding isolation . . . [that] some of the numerous taxonomic entities that have been recognized . . . may be justified on the basis of morphological ground but, as no comprehensive morphological study of *Cannabis* has yet been published, all recognized taxa in *Cannabis* must be viewed with suspicion at present."

A complete clarification of the biology and systematics of *Cannabis* will, of course, require extensive field studies in those areas of Asia where the genus is presumably native or at least has not been subjected to intensive agricultural influence. Sufficient research has not been carried out to establish all of the general trends in the specific delimitation of the genus. Important aspects still remain unclear. Whether there are two or three—or

possibly even more—species is still open to question, as is the correct nomenclature of the specific concepts involved.

But in the basic question of whether *Cannabis* be monotypic or polytypic, we have little hesitation with the evidence available at this point in accepting the polytypic concept.

Central Asia and adjacent regions to the south and west comprise a vast area which includes a great diversity of geographical zones and ecological situations. It is here that *Cannabis* is commonly believed to have originated, although it may be difficult to pinpoint any specific area of origin or to determine how great the geographical distribution of wild hemp was before the advent of man (5, 29, 31). In such a region, there could easily have arisen divergent populations sufficiently distinct both morphologically and ecologically, to be considered species, subspecies and varieties.

When man began to domesticate one or more of these species of *Cannabis* and carry them from place to place, hybridization occurred between the wild species and the incipient cultivars.

Through continual introgressive hybridization with cultivated hemp, some of the original wild species of *Cannabis* may have gradually become extinct. This process increased the variability in the gene pool of the cultivated plants and must have imparted to them some of the unique characters of the wild species. This belief is given credence by the fact that we find great morphological variation between populations of cultivated hemp in various parts of Eurasia in characters which have *not* been selected for by man, such as leaf size and shape and pigmentation of stem and fruit.

Studies in the reproductive biology of different strains of cultivated *Cannabis* indicate that these plants are fully interfertile (17, 22). This does not mean, however, that

sterility barriers may not exist within the genus, specifically in wild populations which have not yet been examined for this character. They may, indeed, show varying degrees of reproductive isolation.

Reproductive isolation can, of course, occur by means other than sterility barriers. It is well known that, in certain genera of plants, as in some animals, "acceptable" species exist where there are few or no sterility barriers present. The examples are many. These species have evolved with other types of isolating mechanisms, that are either mechanical, ethological or geographical.

The significant phenomenon in *Cannabis* is that the combinations of morphological and anatomical (and possibly also chemical) characters have maintained their integrity, in spite of hybridization. The maintenance of these combinations of characters is a better indication of these reproductive barriers than that resulting from experimentation with cultivated strains of doubtful origin.

It is, furthermore, well recognized that species concepts must necessarily vary from one genus to another and from one family to another, dependent on the genetic peculiarities of the group under consideration. With the very different genetic backgrounds in different families, genera, etc., it is not at all surprising that the patterns of variation in these sundry groups may be quite different. There is not the equivalence of units amongst families of plants in the same sense of elements in chemistry. At one time, it was hoped that the species might be so rigorously defined that it would serve as the unit of evolution. Taxonomy has come a long way, however, since this belief, and taxonomists now hold that the population is the evolutionary unit, the biologically significant unit in plants.

Plants were not made to be catalogued and classified. They can never easily and with complete satisfaction be

put into tight compartments. This simple and basic truth, usually not appreciated by non-scientists and sometimes overlooked by zealous taxonomists, should be borne in mind much more strongly for groups such as *Cannabis*, where an historical perspective is imperative.

III

In view of the excessively confused taxonomic picture of *Cannabis* that at present confounds botanical, chemical, legal and other considerations, a review of the specific history of the genus may be illuminating.

The history of *Cannabis* in modern taxonomic literature began in 1737, when Linnaeus established the genus *Cannabis*, basing it on pre-Linnaean concepts.

The name *Cannabis* (Greek *Κάννabis*, *Kannabis*) is a very ancient classical vernacular name for hemp, with which the English word *hemp* itself, derived from the Anglo-Saxon *haenep* and the presumed Old Teutonic parental form *hanapiz*, are cognate; and, according to Laufer (11), "is presumably a loan word pointing to Finno-Ugrian and Turkish", ancient languages of central Asia. Indeed, the principal difference between the Teutonic and the Graeco-Latin forms is due to the Gothic consonant shift—Greek preserving the consonant *k* of an earlier Indo-European language which became *h* some five centuries or so B.C. in the primitive Teutonic languages. Thus, etymology accords with other evidence in indicating central Asia as the area whence plants of *Cannabis* spread outwards, mainly eastward, westward and to the south.

The binomial *Cannabis sativa* was published by Linnaeus in *Species Plantarum* in 1753, the internationally accepted starting point for modern botanical binomial nomenclature. *Cannabis sativa* harkens back to pre-Linnaean literature.

Under *Cannabis sativa*, Linnaeus referred to several

earlier synonyms: *Cannabis foliis digitatis*, used in his *Hortus Cliffortianus* of 1738; *C. sativa* and *C. erratica* of Bauhin in 1623; *C. mas* and *C. femina* of D'Aléchamps in 1587.

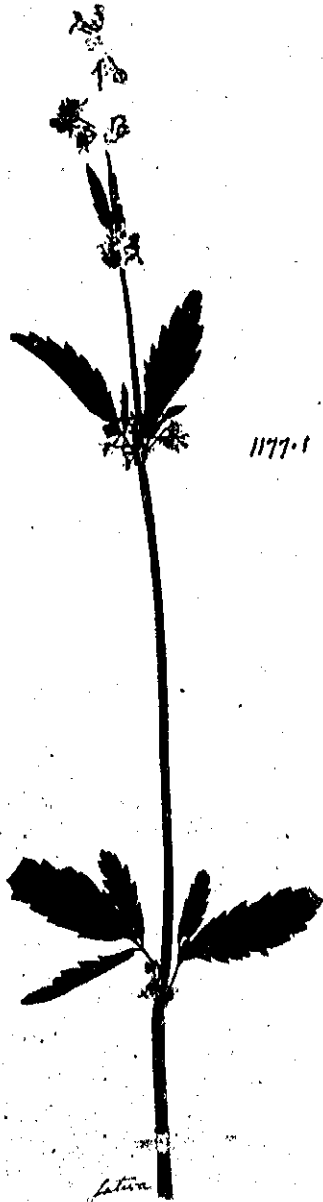
The Linnean Society of London preserves in the Linnean Herbarium two species of *Cannabis*. One specimen, No. 1177.1*, is labelled "*sativa*" in Linnaeus' handwriting and represents a staminate plant with much more abbreviated leaves than is usual for what we consider normal for *Cannabis sativa*. The other specimen, No. 1177.2*, without any specific epithet written on the sheet, represents a pistillate plant with the lanceolate leaflets that are commonly encountered in *Cannabis sativa*.

No locality data are found on these two collections, although, in *Species Plantarum*, Linnaeus offers the information that the species has a "habitat in India". In his annotated copy of *Species Plantarum*, preserved in the Linnean Society, Linnaeus had written in his own hand, as a note for any future edition, the word "Persia" as an additional habitat. It should, of course, be borne in mind that, in Europe in 1753, geographical delimitations were far from strict and that "habitat in India" and "Persia" represented extremely vague and wide areas, undoubtedly not corresponding precisely with today's India and Persia. Indeed, Linnaeus' "India" is often equivalent to modern China.

It is clear that these two specimens were not in Linnaeus' herbarium in 1753. He added them later. Linnaeus did not cite any specimens in his *Species Plantarum*, nor did he offer any description of his *Cannabis sativa*. He based his recognition of *Cannabis sativa* on the kind of hemp commonly cultivated in northern

* Index number assigned to specimen in the Linnean Herbarium by the late M. Spencer Savage, Secretary of the Linnean Society of London.

PLATE XXXI



Specimen No. 1177.1 of Cannabis in the Linnean Herbarium.
Courtesy: Linnean Society of London.

European gardens at that period. Stearn (24) has typified *Cannabis sativa* by choosing as lectotype a pistillate specimen from *Hortus Cliffortianus* and now preserved in the British Museum (Natural History). Until this typification was made, there might well have been doubt as to what Linnaeus actually meant by *Cannabis sativa*, regardless of the general use of this binomial for more than two centuries.

Although the two specimens in the Linnean Herbarium are of little taxonomic or nomenclatural significance, since neither one can be a type, there seems to be no reason to doubt that Linnaeus considered them to represent what he had already called *Cannabis sativa*. Consequently, it would be of interest if we could somehow ascertain the provenience of these two specimens. His annotation "habitat in India" does not constitute a guarantee that he had seen specimens that actually had come from Asia. Linnaeus was, of course, familiar with hemp as cultivated in northern Europe, including his native Sweden, and there is a strong probability that these two later specimens may have been locally collected.

Although very scanty, the two specimens in the Linnean Herbarium are of very different aspect. The pistillate specimen (1177.2) has leaves with fewer than the usual number of leaflets; the leaflets are long, linear-lanceolate, long-acuminate, with very sharply pointed but not coarse serrulation. The staminate specimen (1177.1) is very distinctive, with trifoliate leaves, the leaflets of which are short, elliptic to somewhat elliptic-lanceolate, apically almost blunt, with coarse, not markedly pointed serrulation.

Even though the type method in taxonomy was not employed in Linnaeus' time and although Linnaeus did not have these two specimens at hand in 1753, it is interesting and perhaps significant that the staminate

PLATE XXXII



Specimen No. 1177.2 of Cannabis in the Linnean Herbarium.
Courtesy: Linnean Society of London.

specimen (1171.1), which does not resemble the concept that we now commonly recognize as *Cannabis sativa*, is actually the specimen upon which Linnaeus wrote "sativa". There is no indication of a specific epithet written on the other specimen (1177.2).

With the thousands of herbarium collections now available for study and years of attention to cultivated forms in many parts of the world, taxonomists should be able to examine these two specimens with much more perspicacity than Linnaeus himself was able to do. The question arises—even though this material is not critical to our taxonomic studies in the genus—"Why are these two specimens so very unlike? Was the staminate specimen on which Linnaeus wrote "sativa" a branch from an abnormal plant? Or did perchance Linnaeus actually have at hand after 1753 representatives of two different species?

Although he did no basic taxonomic study on *Cannabis*, Scopoli, in 1772, twenty years after Linnaeus' publication of *Cannabis sativa* and the name of the hops plants, *Humulus Lupulus*, reduced the genus *Humulus* to synonymy under *Cannabis*, calling the hops plant *Cannabis Lupulus*. This point of view has never gained acceptance, although both genera, *Cannabis* and *Humulus*, are now almost unanimously considered to be closely allied and to be members of the same family, *Cannabaceae*.

Thirty years after Linnaeus' *Species Plantarum*, in 1783, the French naturalist Lamarck described another species, *Cannabis indica*, in his *Encyclopédie Méthodique*. This new species was based upon a specimen certainly of Asiatic origin. According to Lamarck, it was collected by a French naturalist, M. Pierre Sonnerat (1748(49)-1814) in India. Again, we are at a loss to indicate a definite area, partly because of vagueness of geographical

terminology in that period and partly because, in the same paragraph, Lamarck reports that the plant grows in the "East Indies". He undoubtedly meant "eastern India", where Sonnerat did collect, for it is known that *Cannabis* was introduced into what is now called "East Indies" much later. Sonnerat travelled between 1768 and 1771 in Madagascar, India, Ceylon, the Philippines, Indonesia and China; he spent some time collecting in Pondicherry and southern India.

Lamarck considered his *Cannabis indica* to be a species "very distinct" from *C. sativa*. He reported it to be of a smaller stature, more profusely branched and provided with a much harder (woodier?), almost cylindrical stem. He further stated that the leaves are constantly alternate; the leaflets narrowly linear-lanceolate and very acuminate. The staminate plants have five or seven leaflets; whilst the pistillate plants are commonly three-foliolate, with the leaves near the summit being completely simple. The pistillate flowers he described as having a pubescent calyx and long parallel styles. Because of its hard stem and thin cortex, this species, he maintained, was not capable of furnishing fibres similar to those provided by *Cannabis sativa*. The odour of Lamarck's species was, in his words, "strong and resembling somewhat that of tobacco". In a paragraph following the description of *Cannabis indica*, Lamarck pointed out that the principal virtue of this species lay in the strength of its narcotic properties.

At first glance, a photograph of the specimen on which Lamarck based the name *Cannabis indica* does not show a significant difference from Linnaeus' pistillate specimen No. 1177.2. But when one studies the photograph and the actual specimen (preserved in Paris) critically and against a background of experience with material of *Cannabis*, the specimen appears to have been taken from

a plant of a much denser and more compact growth than the Linnaean specimen which gives the impression of having come from a rather laxly branched plant. We have also Lamarck's direct remark that the plant is "smaller" and "very much branched", which might well be interpreted to indicate a plant with branches more densely spaced than is the usual condition in what has long been called *Cannabis sativa*.

There were no further developments in *Cannabis* taxonomy and nomenclature until 1792, when the French botanist Gilibert published *Cannabis foetens* in his *Evercitia Phytologica*. This work, which is not consistently binomial, did not accept Linnaean names. After a very adequate description of what is obviously *Cannabis sativa* (as now typified), he commented mainly on differences in growth habits between the *Cannabis* that he knew in France and that which he had found in Lithuania. There is no indication that he was attempting to differentiate *Cannabis foetens* from *C. sativa*. The name *Cannabis foetens* must, therefore, be considered a *nomen illegitimum*.

The next event in the nomenclatural history of *Cannabis* was Sievers' casual enumeration in 1796 of "*Cannabis erratica*" (a binomial dating from pre-Linnaean times) in a list of plants encountered on a trip to Siberia. Since Sievers did not describe this binomial, it represents a *nomen nudum* without scientific status.

Half a century after Linnaeus' publication of *Cannabis sativa*, Stokes described *Cannabis macrosperma* in 1812 in his *A Botanical Materia Medica*. While Stokes legitimately described the concept, no specimen is cited and no locality is given, although, by inference, Asia—and probably India—is indicated. There is little hope that we can now ascertain what Stokes had at hand, but it is probable that he had an unusually large-seeded form of either *Cannabis sativa* or *C. indica*. He distinguished his

Cannabis macrosperma from what he considered to be *C. sativa* (with "nuts lenticular-globose") on the basis of its "oblong" achenes, indicating without explanation of his exact meaning, that the new species "is from *C. indica*".

In 1849, the name *Cannabis chinensis* appeared in a seed catalogue issued by the Montpellier Botanical Garden in France. This binomial is a *nomen nudum* referring probably to a form of cultivated hemp from China.

In Sturm's *Flora von Deutschland* of 1905, E. H. L. Krause published the description of a new species, *Cannabis generalis*, stating that its original home was Asia and, without distinguishing the two concepts, indicating that it represents a species present in the flora of Germany in addition to *C. sativa* and *C. indica*. No type specimen is cited. The description and illustration of *Cannabis generalis* indicate it to be one of the many European variants of the concept that has long gone under the name of *C. sativa*.

In 1911, Houghton and Hamilton published the binomial *Cannabis americana* to refer to "American grown hemp". The binomial is another *nomen nudum*, published without a description and with the clear indication that the authors believed it to be synonymous with *Cannabis sativa*. It need not enter any taxonomic consideration and is mentioned here only because—to the confusion of *Cannabis* nomenclature—it has been cited in later uncritical pharmacological literature.

Crévest published the binomial *Cannabis gigantea* in 1917 for a kind of hemp grown in Indochina. No description, no citation of specimen, no precise locality were given. The heading of his discussion of hemp in Indochina "*Cannabis sativa* (Lin.) et *Cannabis gigantea*" constitutes a clear indication that he considered the two concepts to be different species. Although referring possibly to a distinct kind of *Cannabis*, the binomial cannot

enter into any modern consideration of *Cannabis* taxonomy.

The most recent taxonomic innovation in understanding the genus *Cannabis* is that of the Russian botanist Janischewsky who, in 1924, published a new species, *C. ruderalis*. This species is reputed to occur in the wild state in the Volga region, western Siberia, central Asia, and now to be widespread, probably in a weedy state, in northern and central Europe and Russia. According to its author, *Cannabis ruderalis* differs from *C. sativa* in a number of characteristics of a morphological nature (darker colored akene covered with a special coat representing the remains of the calyx and with a caruncle-like growth at the articulation of the akene) and of a biological nature (the akene falling easily and germinating the following spring).

IV

Preliminary examination of the wood anatomy of material which we collected in Afghanistan and which we believe to represent *Cannabis indica* discloses differences from that of material of *C. sativa* grown in the United States. This research, being carried out by Dr. Loran C. Anderson of Kansas State University, is in its preliminary stages and will be the subject of a later paper. The anatomical differences between these two species are very substantial, and Dr. Anderson feels that some comparable differences in other groups of plants might be given even generic status. In this connection, it should be noted that earlier anatomical investigations in Russia (15) indicated important differences which seemed to point to three "types" of *Cannabis*. It was also probably anatomical differences which were basic to Lamarck's statement in 1783 that one characteristic which distinguished *Cannabis indica* from *C. sativa* was its much harder, woodier stem.

PLATE XXXIII



Cannabis indica Lam.

Type specimen of *Cannabis indica* Lam. in the Lamarck Herbarium,
Muséum d'Histoire Naturelle, Paris.

Courtesy: Muséum d'Histoire Naturelle.

The differences in growth habit are extraordinary. It is true that, in some localities, cultivated and escaped hemp may be of hybrid origin and/or, in strongly unfavourable habitats, may show some intergradation or ecotypical adaptation away from the norm.

These differences in growth habit we believe to be deeply significant. We have ascertained from our collections and studies in the extensive Mississippi plantation and elsewhere that the characters of growth habit seem to be genetically stable and are not obliterated by edaphic or environmental conditions. *Cannabis sativa* tends to be a tall—sometimes an extremely tall—very loosely branched plant, with the branches distant from one another; the habit of this species can perhaps best be described by the popular term *gangling*. What we consider to represent *Cannabis indica*, on the other hand, is usually a low, conical or pyramidal plant, normally three to four feet tall, very densely branched, with the branches extraordinarily close one to the other. Lamarck, in describing *Cannabis indica*, noted that it differed from *C. sativa* in its smaller stature and its more profuse branching. *Cannabis ruderalis* is reported to be very small, normally up to two feet in height, often only slightly branched or even unbranched at maturity.

We believe also that we can discern a general tendency in leaf variation, although, as in many plants, this character is far from being a conservative one. Furthermore, sufficient comparative studies have not been carried out for the full extent of the reliability of this character to be utilized. We would, however, indicate that the leaflets of *Cannabis sativa* appear, in the main, to be very narrowly linear-lanceolate, with fine and very sharp serrations. *Cannabis indica*, on the other hand, appears generally to have somewhat broader leaflets in relation to their length and to have somewhat coarser serrations

PLATE XXXIV



Cannabis sativa (pistillate individual) grown spontaneously in Illinois.
Photograph courtesy Alan Haney.

that are not so sharp or which may be even somewhat obtuse. It is true that this character does not appear to be so striking in Lamarck's type specimen as it seems to be in the very ample herbarium material now at hand. The venation of the leaflets of *Cannabis indica* likewise appears, as a general trend, to be much coarser than in *C. sativa*. In *Cannabis ruderalis*, the perceptible tendency seems to suggest leaflets which are very broad in relation to their length and which are much smaller (i. e., much shorter) than in either of the other two species. Since there is such extreme variation in leaf characters—at least, such *apparent* variation in view of the preliminary nature of our studies—we have preferred not to insert leaf characters into our key. The species can easily be distinguished, we feel, without recourse to characters which at present are not thoroughly investigated.

Furthermore, there may be—and we strongly suspect that there are—significant chemical differences, not only in the cannabinolic content but in other constituents, such as the essential oils, flavenoids and possibly several other classes of secondary compounds. Lamarck suggested as early as 1783 that the content of the intoxicating principal was higher in *Cannabis indica* than in *C. sativa*. In the intervening 200 years, during which the epithet *indica* has been used, there has usually been the inference that it is a more strongly intoxicating form of *Cannabis*. Unfortunately, however, almost no chemical studies have been made in association with taxonomic studies nor on the basis of voucher specimens. Throughout the modern Russian literature there exists the inference, if not the outright claim, that the cannabinolic content of *Cannabis indica* is higher than that of *C. sativa* and *C. ruderalis*. Pertinent to species differentiation on a chemical basis may be the unexpected, recent discovery, made independently by several workers (6,

PLATE XXXV



Cannabis indica (left: pistillate individual; right: staminate individual) in fields near Kandahar, Afghanistan. Pistillate plant: source of specimen *R. E. Schultes 26505* (Econ. Herb. Oakes Ames).
Photograph: R. E. Schultes.

16, 26, 27), that chemical differences in *Cannabis* appear to be based more on a genetic basis than on environmental or edaphic factors. If this be so, then it may add still another argument for specific differentiation in the genus.

Vavilov and Bukinich, for example, after long field studies in Afghanistan, maintained that *Cannabis* comprised several species (30). In the *Flora of the U.S.S.R.*, Komarov accepted the polytypic nature of the genus (10). Zhukovsky, in his masterly *Cultivated Plants and their Wild Relatives*, accepts three species of *Cannabis* and indicates their morphological differences (31). In 1960, Soják asserted that *Cannabis ruderalis* is spreading westward into Europe proper and described $\times C. intersita$ —a hybrid between *C. ruderalis* and *C. sativa*—on the basis of a Wallich collection in 1831 (23). The *Flora Europaea* accepts a polytypic composition of *Cannabis*, listing *C. sativa* and *C. ruderalis*—and this in a modern synthetic work which states that “all available evidence, morphological, geographical, ecological and cytological has been taken into consideration in delimiting species. . . . [but which] are in all cases definable in morphological terms” (28).

While we recognize our present incomplete knowledge of characters, we offer the following key to distinguish the several species discussed above.

- 1) Plants usually tall (up to five to 18 feet), laxly branched
Akenes smooth, usually lacking marbled pattern on outer coat,
firmly attached to stalk and without definite articulation
C. sativa
- 1A) Plants usually small (four feet or less), not laxly branched
Akenes usually strongly marbled on outer coat, with a definite
abscission layer, dropping off at maturity
- 2) Plants very densely branched, more or less conical, usually
four feet tall or less. Abscission layer a simple articulation at
base of akene
C. indica
- 2A) Plants not branched or very sparsely so, usually one to two
feet at maturity. Abscission layer forms a fleshy caruncle-like
growth at base of akene
C. ruderalis

PLATE XXXVI

ECONOMIC HERBARIUM
OF
OAKES AMES



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ИСТИСЛАВИТЕЛЬСТВО РАСТЕНИЙ
И НАСЛЕДИЕ ИХ НАУЧНО-ИССЛЕДОВАТЕЛЬСКОМУ
ЦЕНТРУ ИМЕНИ В.И. ВАСИЛЬЕВА

Cannabis ruderalis Jan. Sch.

УСЛ. ПОСЫЛКАМ НАУЧ. ЦЕНТРА ИМЕНИ В.И. ВАСИЛЬЕВА
И НАСЛЕДИЕ ИХ НАУЧНО-ИССЛЕДОВАТЕЛЬСКОМУ
ЦЕНТРУ ИМЕНИ В.И. ВАСИЛЬЕВА

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СССР, ТАДЖИКИСТАН
г. Душанбе

Cannabis ruderalis Jan. Specimen from the Herbarium of All-Union N.I. Vavilov Institute of Plant Industry (Wir). Soviet Union, Tadzhikskaja SSR. Isfarinski Raion, Kishlak Chorku. V Poseve Pshenitsy. Alt. 1150 m. July 15, 1969. T.N. Ul'ianova sine num. (Econ. Herb. Oakes Ames).

V

Acceptance of a polytypic composition of the genus *Cannabis* should not really lead to so much opposition as it seems to have caused in some botanical circles. As has been pointed out above, this opinion is nothing new and has been substantiated by critical work in wild populations.

But there have been even greater changes in our concepts of *Cannabis*. For many years, the family to which *Cannabis* belongs has been uncertain. Early taxonomists tended to put *Cannabis* in the *Urticaceae*, the Nettle Family. Then, botanists tended to allocate the genus to the *Moraceae*, the Fig Family. Now, almost all botanists are in agreement that *Cannabis* should be classified in a separate family, the *Cannabaceae* (sometimes incorrectly called the *Cannabinaceae* or *Cannabidiaceae*), which includes only two genera: *Cannabis* and the genus of the hops plant, *Humulus*. This change in outlook is much more drastic than the change from a monotypic to a polytypic concept of the specific composition of the genus—yet it has come about without the opposition which the proposal of several species instead of one extremely variable species has met in some circles. Furthermore, the change in understanding of the chemical makeup of the genus during the past few years—from four or five to more than twenty-nine cannabinolic structures—has been even more drastic.

VI

The principal field work on *Cannabis* was carried out more than forty-five years ago. We now have available more sophisticated and interdisciplinary techniques for arriving at taxonomic evaluation of generic, specific and subspecific classification of plants, especially of cultivated plants which have been manipulated and drastically altered through agricultural and horticultural practices extending over thousands of years.

The time is long overdue when a full study of Cannabis taxonomy must be initiated. Cannabis has not received the taxonomic attention commensurate with its position as an ancient domesticate; as an important crop throughout most of man's history; as a genus with many interesting and varied uses; as the source of a narcotic, the use or abuse of which perplexes modern society; and as a plant which, through modern phytochemical investigations, holds promise for even greater significance to the material and cultural evolution of humankind.

VII

The genus Cannabis was described in 1737 by Linnaeus:

Cannabis *Linnaeus* Gen. Pl. (Ed. 1) (1737).

Since the beginning of modern botanical nomenclature in 1753, the following specific epithets have been proposed in Cannabis.

Cannabis americana Houghton et Hamilton in Am. Journ. Pharm. 80 (1908) 17, *nomen nudum*.

Cannabis erratica Sievers ex Pallas Neue Nord. Beytr. 7 (1796) 174, *nomen nudum*.

Cannabis foetens Gilibert Exercit. Phytol. 2 (1792) 450, *nomen illegitimum*.

Cannabis generalis E. H. L. Krause in Sturm Fl. Deutschland, Ed. 2, 4 (1905) 199.

Cannabis gigantea Crévost in Bull. Econ. Indochine, n.s., 20 (1917) 613.

Cannabis indica Lamarek Encycl. 1 (1783) 695.

× *Cannabis intersita* Soják in Novit. Bot. Del Sem. Hort. Bot. Univ. Carol Praga (1960) 20.

Cannabis Lupulus Scopoli Pl. Carniol., Ed. 2, 2 (1772) 263.

Cannabis macrosperma Stokes Bot. Mat. Med. 4 (1812) 539.

Cannabis pedemontana Camp in Journ. N.Y. Bot. Gard. 36 (1936) 114, *nomen nudum in synonym.*

Cannabis ruderalis Janischewsky in Uchenye Zap. Gos. Saratov. Univ. 2, pt. 2 (1924) 14.

Cannabis sativa Linnaeus Sp. Pl. (1753) 1027.

Note: This paper is an extension of a lecture delivered by one of the authors (Schultes) on August 29, 1973 at a conference entitled *Cross-cultural perspectives on Cannabis* which preceded the IX International Congress of the International Union of Anthropological and Ethnological Studies, Chicago, Illinois and coordinated by Dr. Vera Rubin, Research Institute for the Study of Man; and on September 5, 1973 at a colloquium entitled *Cannabis sativa—Influence of Genetic and Environmental Factors* in the XXXIII International Congress of Pharmaceutical Sciences, Stockholm, Sweden.

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