

Marijuana ?

The plant *Cannabis Sativa*, also known as marijuana, presents unique issues in our justice system, not the least of which is its identification both by law enforcement officers as well as forensic crime laboratories. A review of the Handbook of Forensic Drug Analysis¹ notes that “the identification of marijuana or its chemical constituents has long been one of the most often performed analyses in the forensic drug laboratory. This includes analysis of the very common botanical samples, ranging from whole plants to finely chopped vegetation...” The authors tell us that in 1972 John Thornton and George Nakamura presented an analytical protocol for the identification of marijuana which required microscopic analysis of botanical features as well as the Duquenois-Levine test, a chemical spot test². But what is it that we are identifying with this protocol? In a 1969 paper Nakamura³ noted that *cannabis sativa* is classified as follows:

Division: Spermatophyta (seed plants)
Class: Angiospermae (flowering plants)
Subclass: Dicotyledons (dicots); 31,874 species
Order: Urticales (elms, mulberries, nettles, and hems); 1753 species
Family: Cannabinacea (hops and marijuana); 3 species

¹ Charles Tindall, et. al., *Cannabis: Methods of Forensic Analysis*, in Handbook of Forensic Drug Analysis (Elsevier Academic Press, 2005)

² J.I. Thornton and G. R. Nakamura, *The Identification of Marijuana*, Journal of Forensic Science Society , V12, 461 (1972).

³ G. R. Nakamura, *Forensic Aspects of Cystolith Hairs of Cannabis and Other Plants*, Journal of the AOAC V52, 5, (1969)

Genus: Cannabis

Species: Sativa

Therefore we are looking for a plant which produces seeds and has flowers and is a dicotyledon with some or all of the features of elms, mulberries, nettles and hemsps.

We must start our analysis of marijuana with an understanding of just what form the alleged marijuana takes in its presentation to the analysts. Tindall et. al.⁴ tell us that most submissions to forensic laboratories are in the form of crushed plant material which no longer retains gross botanical features. What that means is that “plant” material is seized by law enforcement officers who “recognize” it as marijuana despite the fact that it no longer retains gross botanical features. This, of course, depends upon the law enforcement officer’s ability to determine that he is observing plant material. On the surface of this it seems ridiculous to believe that any individual could not determine that a plant is a plant. We see plants every day and recognize them as trees, grass, ornamental flowers about our homes, and the ever present weeds in our gardens. On this level of understanding we would most appropriately go not to a treatise on botany but to a dictionary to determine the definition of a plant. We see, for instance, that the New College 1975 Edition of The American Heritage Dictionary of the English Language defines a plant as “Any organism of the vegetable kingdom, characteristically having cellulose cell walls, growing by synthesis of inorganic substances, and lacking the power of locomotion.” So when the crushed material described by Tindall is seized by a law enforcement officer we would hope that in defining the material as “plant” material that officer would refer his definition to a standard such as we have above from the dictionary. Can we determine from a

⁴Supra note 1.

field examination of crushed material if the seized material is composed of cells with cellulose cell walls? Well, not really. Such a determination requires at the least a microscopic analysis as well as a chemical analysis. History books tell us of the excitement hundreds of years ago when newly invented microscopes detected the presence of the cellular structure of living matter. If before microscopes came along we could not see those cells then how is it that the police officer on the street can see those cells with the naked eye. The cellulose making up the walls of those cells requires a chemical analysis so how can a police officer on the street determine the cell walls are composed of cellulose? Can the officer determine if the material lacks locomotion? Of course he can. Even parts of a dead animal or pieces of newspaper lack locomotion. The valid question would be “Did the seized material in its natural state exist in an object that lacked locomotion?” We can’t know that. The material is no longer in its natural state. And then will the law enforcement officer know whether the material he has seized grows by the synthesis of inorganic substances? The answer to this question, of course, is that he will not know this. And so how does the law enforcement officer know that he even has a plant material?

Let us suppose that by some method the seizing officer can determine that he has seized plant material simply by looking at it. If Nakamura is indeed correct in his classification of marijuana then we go to the next level of analysis and that is to determine if the material which has been seized is a seed plant, a Spermatophyte. Let us assume that the material is a plant and then look for seeds. The author’s own law enforcement experience in the investigation of marijuana cases has shown that very often seized “marijuana” samples do have what are described as seeds in the containers in evidence. But are these object really seeds? How do we determine that? Do we plant them to see if they grow? Do we open them up to see if there are

two halves (two cotyledons) and the tiny beginnings of a plant? Even if we can determine that these are seeds if they are present, how do we know that they are seeds of Cannabis Sativa? How do we differentiate these seeds from any other seeds?

Let us assume that we have answered the questions concerning whether we have plant material which has seeds. Then we must ask, according to Nakamura's scheme, if the seed plant we have seized has flowers or is an Angiosperm. That question demands that we know what a flower is, the different parts of flowers, the kinds of flowers which we see in a growing standard of marijuana and if the flowers seen in marijuana are like flowers in any other kind of plant. Just because marijuana flowers appear to have particular features one can not assume that no other plants have flowers with the same features. When one considers the form in which most "marijuana" samples are seized, the crushed plant material, then one can imagine that even if flowers are in the seized material, the features of those flowers remaining after crushing may very well not allow one to determine if they are identical to marijuana flowers.

Now suppose that we can determine that we have plant material, that those plants are Spermatophytes (seed plants) and are Angiosperms (have flowers). Do we then know whether they are Dicotyledons. Anyone who has ever planted a bean as a child or a watermelon seed or a peanut knows what a dicotyledon is. Those first little fat leaves that form from the seed itself, the seed leaves, are the cotyledons. We see those and initially wonder what we have planted, why it looks so different from what we expected of our planting project. But soon those cotyledons give way to tiny little leaves and our plants grow up to look like we expected. The seed leaves are the cotyledons. Plants which have two cotyledons are referred to as Dicotyledons. Nakamura tells us that the literature he referenced noted that there were 31,874

known dicotyledons. Then, because real marijuana is a dicotyledon we ask the real question, “Can we determine from looking at the material in that seized crushed seed plant bearing flowers if the material is a dicotyledon?” Unless at the seizure or in the lab we look at the seeds, if they exist, or unless we plant those seeds and look closely at them when they emerge from the soil we can not know if we have a dicotyledon. Though a trained botanist might be able to discern that a plant is a dicotyledon, as we see from statements from Tindall⁵, most “seized drug analysts are not trained as botanists”.

Now suppose that we have somehow determined that we have plant material from plants that have seeds and flowers and are dicotyledons. Because even Nakamura recognizes that there are many,many dicotyledons we recognize that we need to be able to discern the difference between marijuana and all the other dicots. We see from Nakamura’s paper that a further subdivision called an “order” named “Urticales” exists and contains elms, mulberries, nettles and hemp of which he says that there are 1753 species. The question then presents itself as to whether the law enforcement officer can determine from examining that crushed material in the baggy he has just seized if the material originated from a plant which had the features of plants in the order Urticales. Now put this paper down that you are reading and go take a break. Go out into your back yard and look around you at the types of plants you can see. Look at the myriad of different shapes of leaves on trees, plants in your garden, even the weeds that grow in those gardens. You might be looking at 100 species of plants right now. Take some of those leaves into your office and let them dry for a week or two. Then crush them up. Can you now differentiate those leaves in their crushed up form just by looking at them and tell from which

⁵ Supra note 4, at p.48

plant you took them? A review of a later edition of one of the sources that Nakamura referenced, *Anatomy of Dicotyledons*⁶, notes that leaves are classified according to leaf orientation, leaf organization, leaf shape, form of the leaf margin, leaf texture, gland position, petioles, types of venation, and elements of tooth architecture. Looking further into just one of these, form of leaf margin, we see classification concepts referred to as “entire, lobed, toothed, crenate, erose, revolute or enrolled sinuses, spacing, and series”. Without even defining the meaning of any one of these we can ask ourselves where the plants we are examining fit into this classification scheme. How did the leaves appear before they were crushed up and prepared for distribution? We may very well not be able to provide this information therefore how can we say we are looking at marijuana?

If indeed we have found that the material is seed bearing and flower producing dicotyledonous and having the characteristics of those plants in the order Urticales then we can further ask about the description of the flowers. We know from our experience of simply looking out into our gardens that all flowers were not created equally. Day lilies certainly look very much different than roses. So we can assume that the flowers of marijuana may be different from other flowers. Nakamura again is our guide referring us to Hayward’s treatise, “The Structure of Economic Plants”⁷. Hayward, a Professor of Botany at The University of Chicago, provides us what seems an exhaustive description of the inflorescences of marijuana, only part of which is included as follows:

⁶ Leo J. Hickey, *A Revised Classification of the Architecture of Dicotyledonous Leaves*, in *Anatomy of the Dicotyledons* 25-39, (C.R.Metcalf and L. Chalk, 2d Ed. Clarendon Press 1979)

⁷ Herman E. Hayward, *The Structure of Economic Plants*, (MacMillan Company, 1938)

“Although hemp is dioecious, it is not uncommon for an individual plant to bear both staminate and carpellate flowers...”

So have we seen evidence of either staminate or carpellate flowers in the crush material the law enforcement officer has presented to us as marijuana? And further:

“The staminate flowers develop in small, drooping, branched panicles, which arise in the axils of foliage leaves...The flowers of the panicle may occur singly on slender pedicels or in groups, and usually the terminal branches bear three flowers...”

Do we see drooping, branched panicles, which arise in axils of foliage leaves and if we do not then can we say with any certainty that we are looking at/have identified this material as marijuana. And do the flowers of the panicle occur singly on slender pedicels or in groups? And further:

“The individual flowers are apetalous with a deeply parted calyx having five greenish-yellow or red lobes that are widespread at maturity”

Have we seen the apetalous flowers with a deeply parted calyx having five greenish-yellow or red lobes widespread at maturity? And further:

“The oval sepals are acuminate, the outer surface and margins being covered with multicellular glands and slender, pointed unicellular hairs with crystals of calcium oxalate deposited in their swollen bases. The inner epidermis is practically devoid of hairs and stomata which are present in the outer epidermis...”

And has the law enforcement officer who has “identified” the “green leafy material” as marijuana or even the forensic lab examiner been able to determine if the oval sepals are acuminate with outer surface and margins being covered with multicellular glands and slender,

pointed unicellular hairs with crystals of calcium oxalate deposited in the swollen bases? Has anyone at all in the “identification” process even determined the presence of calcium oxalate?

So far we see that in order to determine if we have marijuana we need to know if we have plant material, if that material is from seed-bearing and flower-bearing dicotyledonous plants of the order Urticales and if the botanical features of marijuana described by Hayward are identified. Or an alternative would be to determine if marijuana has unique characteristics which set it apart from the universe of plants on planet Earth. Obviously Cannabis Sativa is unique as a species or we would not have called it a “species” of plant. In the 1970's the issue of whether the genus Cannabis was composed of a number of different species of plants came to the attention of the legal community during a period of argument over whether legal statutes properly proscribed the possession and/or distribution of all species of Cannabis or simply Cannabis Sativa. The arguments were rendered moot by legislators and will not be discussed here. What we will ask here is whether one can “identify” Cannabis Sativa to the exclusion of all other plants utilizing the protocol suggested by Nakamura and Thornton and recommended by others⁸ or by simply looking at the material and comparing it to one’s memory of marijuana seen at the “Police Academy” some number of years ago during training as seems to be the trend in the justice system at this time.

⁸ The Scientific Working Group on Drug Analysis (SWGDRUG) in its February 9, 2006 version of its Quality Assurance/Validation of Analytical Methods page 2 notes the use of both macroscopic and microscopic examinations of Cannabis only as methods of analysis.

The United Nations 1987 pamphlet “Recommended Methods for Testing Cannabis, Manual for Use by National Narcotics Laboratories” recommends the examination of macroscopic and microscopic features of suspected marijuana as well as the use of the Duquenois-Levine test.

The Protocol

Nakamura's 1969 paper presented a protocol for analysis of seized alleged marijuana samples as follows:

“A leaf specimen (100 mg sample) was macerated in 25 ml petroleum ether, filtered into a beaker, evaporated to dryness without heating, and tested by the Duq. L test as described by Butler (3).

For morphological examination, leaf specimens were studied under stereoscopic binoculars, 10 to 50X, and a simple compound microscope, 50-100X; the subject was illuminated with narrowly directed reflected light of “Flexilight” unit (Iota-Cam Corp., 28 Teal Rd., Wakefield, Mass.) which is capable of producing 3,000-11,000 candle powers.

Photomacrography was conducted through a 16 mm Zeiss Luminar lens mounted on a 35 mm Leica by aid of Visoflex reflex and bellows attachments. Kodak Panatomic film was used. Unless otherwise indicated, all prints were enlarged to a final 60X magnification for all specimens to provide a size comparison.”

The analysis is as simple as that. Nakamura further notes that “Since most marijuana examined in forensic laboratories is crushed and no longer retains gross botanical characteristics, the presence of cystolith hairs on leaf fragments has been used as the principal criterion for morphological identification.” What are these cystolith hairs described here? A cross section of a marijuana leaf will reveal the presence of bear claw shaped hairs on the top surface of the leaf as well as “clothing hairs” on the bottom of the leaf.. The “bear claws” should also have in their

base large areas containing amorphous(noncrystalline) calcium carbonate. The cross section⁹ of a marijuana leaf should appear as follows:

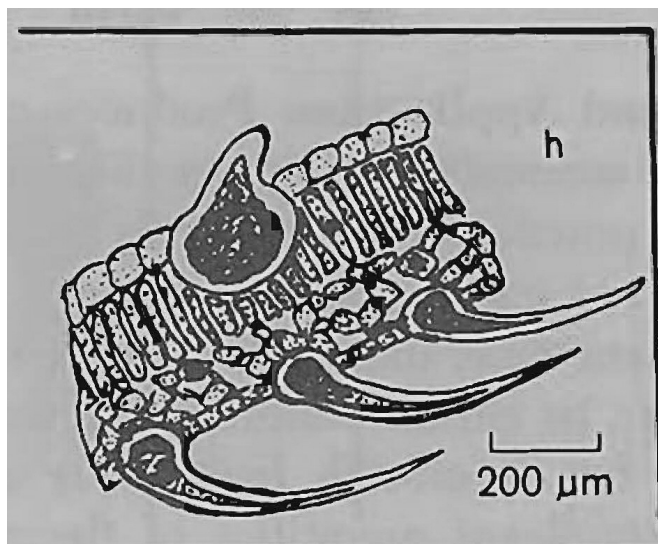


Figure 1

Some of the clothing hairs will also have cystoliths that are smaller than the cystoliths in the “bear claws”. A photomicrograph taken by the author of a cross section of a marijuana leaf appears below:

⁹ Taken from Egon Stahl, Drug Analysis by Chromatography and Microscopy, (Ann Arbor Science Publishers Inc. 1973)

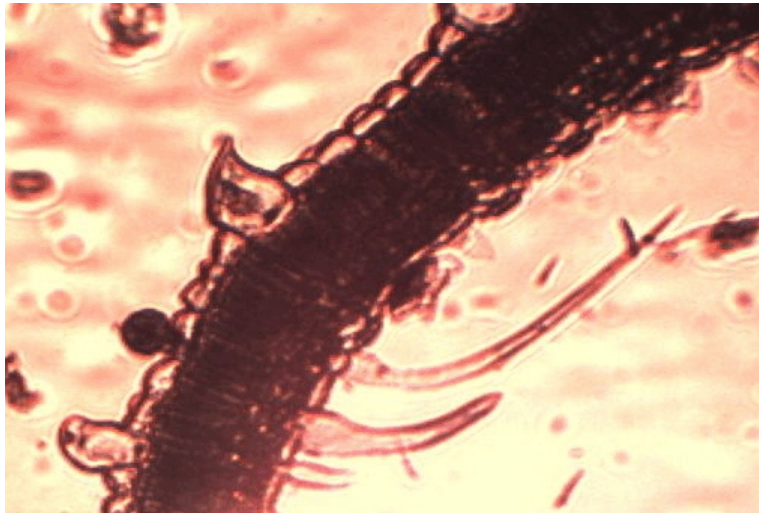


Figure 2

One can see that, though not exactly like the drawing in Figure 1, a bear claw appears on the upper surface of the leaf and longer hairs appear on the bottom surface of the leaf. According to Nakamura the aim of the forensic analyst is to observe these features. Such observation can either be through microscopic analysis of a mounted cross section of a suspected marijuana leaf or through simply microscopically observing the top of the leaf and then turning over that leaf particle and observing the bottom of the leaf. Nakamura notes on page 16 of his 1969 paper that: “Only after a studied examination, under high magnification, can the cystolith hairs of marijuana be tentatively identified. Microscopic identification of marijuana, therefore, depends upon not only on the presence of cystolith hairs but on its association with the longer clothing, or nonglandular hairs, on the other side of the leaf, and if present, the fruits and their hulls, the

glandular hairs, and the flowering tops as set forth in U.S. Treasury Department Manual (1). The Duq. L test should be used in final confirmation.” Nakamura’s dependence upon not only the cystolithic hairs but also “if present”, the fruits and their hulls, the glandular hairs and the flowering tops” is troubling to the analyst who is left with a choice of a protocol without clear parameters. Who will define a protocol in which the minimum characteristics that need to be detected are clearly described? Do we need to see the fruits, their hulls, the glandular hairs and flowering tops or can we simply stop with the cystolithic hairs?

Analysis of the Protocol

Any scientist critically reviewing Nakamura’s paper would first be inclined to ask from where his numbers originated. The number 31,874 describing the number of dicotyledons is a particularly inviting piece of data to review. Nakamura cites the authors Solereder, Metcalf and Chalk as well as Hayward. A review of Solereder’s book¹⁰ immediately brings to one’s attention that this book was written in 1908. If Solereder’s information is the basis for the number of dicotyledons noted by Nakamura then one must wonder if botanists have discovered any new dicotyledons in the past one hundred years since about the time that the Wright Brothers took their first flights on the beaches at Kitty Hawk, North Carolina. Further review reveals that this book was not the principle source of the number of dicotyledons but of discussions concerning the antagonistic relation between size of cystoliths and size of the hairs in which they are found. The bear claws are shorter than the clothing hairs and have larger cystolithic deposits in them. This is a useful piece of information for one to determine if one is looking at bear claws as

¹⁰ Solereder, H. Systematic Anatomy of the Dicotyledons (Oxford at the Clarendon Press 1908)

opposed to clothing hairs but again does not help us with the origin of the number 31,874.

Hayward's book¹¹ also does not provide us with a clue as to where Nakamura came up with the number 31,874 but does give us a very indepth description of the total marijuana plant from one end to the next. Again one must notice that this book was written in 1938 during the Great Depression which begs the question as to how many resources Hayward actually had at his disposal during that time to thoroughly investigate Cannabis Sativa.

A copy of Metcalfe's and Chalk's first edition¹² could not be found by the author however the 1979 edition of this book does provide a list of plant families in which certain diagnostic features occur. The book lists in particular those families of plants of interest to us that contain simple (unbranched) short hairs as well as those which contain simple (unbranched) long hairs. One could reasonably infer from this that Metcalf and Chalk were the original source from which Nakamura derived his number of dicotyledons, 31,874, by cross referencing those plant families that had both types of hairs, then determining the number of species in each family and adding up those numbers. Metcalf and Chalk published their first edition in 1960. Again, one must question the information in light of the fact that close to 50 years have passed since this information was up to date and possibly more dicotyledons have been discovered and classified since then.

So how many dicotyledons are known today. Is it still 31,874 or have scientists discovered more species? A search of the botanical scientific literature discovered a paper by

¹¹ Supra note 7.

¹² Metcalf, V.R., and Chalk, L. *Anatomy of Dicotyledons* (Oxford at the Clarendon Press, 1960)

Robert F. Thorne¹³ in which he reports that there are 199,350 known species of dicotyledons. Thorne's short paper notes also the disagreements within the scientific community concerning the size of this number but quotes other researchers as proffering numbers of flowering plants between 200,000 to 400,000. Therefore one can assume that botanists have been rather busy in the past fifty years and many more flowering plants have been discovered and classified. What does this mean for the "identification" of marijuana based on botanical features and the reaction of a plant to the Duquenois-Levine test. We get the answer from Nakamura himself on page 15 of his 1969 paper: "Representative species that bear cystolith hairs or hairs accompanied by independent calcified growth in the leaf, most of which are similar in structure to those of Cannabis, are listed below. (No attempt was made to prepare a comprehensive listing because of the sheer magnitude of the task of examining 31,874 dicotyledons...)" Nakamura microscopically examined 600 of 31,874 dicotyledons. He found that he could not differentiate 82 of those using his microscope and then subjected those to the Duquenois-Levine test and found that only one of those 82 species gave a positive for marijuana and that was the marijuana itself. But he addressed the sheer magnitude of the task of examining 31,874 species of plants noting that "no attempt was made to prepare a comprehensive listing" due to the sheer magnitude. Are we then left with not really knowing how many more plants than the 600 microscopically examined would have given false positive results for the presence of marijuana. Nakamura's paper is unclear about this as is the 1972 paper by Nakamura and Thornton.

The number of possible alternative plants which may have cystolithic hairs of the same

¹³ Robert F. Thorne, *How many species of seed plants are there?*, Taxon 511-512 V51, August 2002.

description as marijuana has expanded significantly. If we would apply the same analytical scheme to those 199,350 plants, what would be the result? The author has found nothing in the forensic or scientific literature that discusses this issue. Papers that exist assume that the only plant that will give a positive test for marijuana using the Nakamura/Thornton protocol is marijuana. When we “identify” marijuana we declare that the features we see, the data we collect, is unique to marijuana to the exclusion of all other plants. Can we say that today? Can a law enforcement officer without any training, experience or education in at least botany, not to mention the taxonomic features of plants, say that what he is seeing in the evidence he has just seized is marijuana to the exclusion of all other plants? Can the forensic lab examiner after having detected the presence of bear claws as well as clothing hairs on leaf surfaces and then subjecting the material to the Duquenois-Levine test say that those tests uniquely identify marijuana to the exclusion of all other plants? According to Thorne there are 199,349 other plants. Have we tested all of them? Let’s consider what that testing would entail. First we need to acquire the plant specimens themselves. That is not a simple task. We have to locate and travel to an arboretum or a number of them and ask for specimens of plants whose leaves have hairs similar to those found on marijuana leaves. We have to know what those specimens are to ask for them by name. Then we have to conduct a microscopic analysis of each of those plants that have been determined to have long and short single-celled nonglandular hairs. If Nakamura microscopically tested 600 of 31,874 dicotyledons based on the classification of Metcalfe and Chalk that does not mean that we would necessarily test 600 or 6,000 or 60,000. We can not infer that simply because we have expanded our data base by a factor roughly of six that we will then have to microscopically analyze 6 times 600 or 3600 species. We just won’t know the

number of plants that we must analyze until we find which new species have those hairs.

The analysis also entails the use of the Duquenois-Levine test which gives rise to another level of complexity. Approximately at the same time that Nakamura and Thornton were publishing their study of marijuana analysis, Fochtman and Winek of the Toxicology Department of the Allegheny County Coroner's Office, Pittsburgh, Pennsylvania¹⁴ published a note concerning marijuana testing. Noting that the Duquenois-Levine test had been used routinely over the past several decades and the importance of positive identification of marijuana, Fochtman and Winek recommended that further identification be made after the use of microscopic and chemical analysis. They recommended the use of thin layer chromatography or gas chromatography for "positive identification of the cannabinoids in marijuana" and specifically advised that "The microscopic and Duquenois-Levine chemical test should be used as a screening method only,..."

Pitt, et. al¹⁵, working under a grant from the Law Enforcement Association Agency and the State of North Carolina, also agreed with Fochtman and Winek, stating in the conclusion of their paper that:

"In conclusion, it is believed that if the criteria [1,2], for a positive Duquenois test are rigorously adhered to, and botanical evidence is also available, then the Duquenois color test is a reliable screen for cannabinoids. However if botanical evidence is not available, the ubiquitousness of phenols in nature and their diversity of structure makes it mandatory to

¹⁴ Fochtman, Frederick W., and Winek, Charles L., *A Note on the Duquenois-Levine Test for Marijuana*, in *Clinical Toxicology*, 4(2), pp. 287-289, June 1971

¹⁵ Pitt, C.G., Hendron, R.W., and Hsia, R.S., *The Specificity of the Duquenois Color Test for Marijuana and Hashish*, in *Journal of Forensic Science*, V. 17, No. 4, p. 693 (1972)

supplement the colorimetric test with chromatographic evidence. This conclusion is substantiated by the recent report [14 (Fochtman's paper)] that certain commercial brands of coffee give a positive Duquenois-Levine color test."

Thornton and Nakamura¹⁶ seem to disagree with the conclusions of Pitt. et. al. as well as Fochtman and Winek. They note that "Although a rigorous identification of the marijuana plant may be effected through an examination of its botanical characteristics, it is generally considered advisable to perform a chemical test in most instances, and necessary to perform it in others." However despite the fact that they go on to note that "The Duquenois test, the most widely used chemical test, is a somewhat enigmatic reaction whose mechanism is poorly understood." (and which remains so after one reads the Thornton/Nakamura paper) one is lead to believe that the protocol can be used to rigorously identify marijuana. This is despite the fact that so many alternative possible false positives have not been addressed.

The theme of "identity" continues through the paper of Hughes and Warner, Drug Enforcement Administration chemists with the Mid-Atlantic Regional Laboratory, Washington, DC.¹⁷ Despite testing a very limited number of materials and presenting no data concerning the number of possible chemicals one might find in the plant kingdom, Hughes and Warner, with a flair for the ipse dixit, note that "if glandular, clothing, and cystolithic hairs are present then either a modified Duquenois-Levine test or TLC sprayed with Fast Blue B salt are positive evidence that Cannabis is present in the sample." This statement does not say that Cannabis is

¹⁶ Supra note 2.

¹⁷ Hughes, R.B., Warner, V.J., *A Study of False Positives in the Chemical Identification of Marihuana*, in *The Journal of Forensic Sciences*, Vol 23, No2, p 304 (1978)

present, just that the test results are positive evidence that Cannabis is present. This is akin to saying that because my car has four tires we have positive evidence that my car was involved in the bank robbery where a car with four tires was used as a get-away vehicle.

The “myth” involving the infallibility of the Duquenois-Levine test is passed on to others in such papers as that written by Coutts and Jones¹⁸ in which they cite Pitt¹⁹ as stating that few if any other plant products react identically in the Duquenois-Levine test. Without actually reading the Pitt paper we would be left with the impression that we had the solution to this identification issue. We would not know of the pitifully small number of samples Pitt and coworkers actually tested nor would we have any idea of the significance of the number of chemicals found in plants.

The Kurzman Mystery

What the author has presented above is the result of following in the footsteps of Marc G. Kurzman and Dwight S. Fullerton in their paper “Winning Strategies for Defense of Marijuana Cases: Chemical and Botanical Issues.”²⁰ For any scientist the title of this paper alone would be strong warning that the contents were biased, were meant as “Winning Strategies” and would be suspect. (A scientist would simply be looking not for the freedom of his client but for the truth behind the data without concern of consequences to his client.) However this very long and detailed treatise lays out the fundamental flaws in the classical forensic marijuana analytical

¹⁸ Coutts, R.T., Jones, G.R., *A Comparative Analysis of Cannabis*, in *Journal of Forensic Sciences*, V24, p 291 (1978)

¹⁹ *Supra* note 15.

²⁰ Kurzman, M.G., Fullerton, D.S., *Winning Strategies for Defense of Marijuana Cases: Chemical and Botanical Issue*, in *Journal of Criminal Defense*, V. 1, p. 487 (1975)

scheme very clearly so that even lay readers can understand. Kurzman's paper is then not a "trick" to be played on unprepared prosecutors and triers-of-fact but is actually a thorough study of the problem. As Kurzman's paper was written in 1975, it would seem that the use of the "hairs" on marijuana leaves and the "purple" alchemy of the Duquenois-Levine test would have long since been successfully challenged and would no longer be useful as evidence in courts of law. At the very least one would hope that the original experimental design proposed by Nakamura would be revisited and a proper analysis would be conducted of the over 250,000 flowering plants known at this time. But the mystery is it seems that this is not the truth. In fact in many jurisdictions the microscopic analysis and chemical tests are all that is conducted. In some jurisdictions "identification" is even carried out by law enforcement officers with no more than visual, not microscopic, analysis and suspected marijuana is never even sent to a crime lab. The issue that we are left in this mystery is stated so well by Tobin and Thompson²¹:

"The next step for assessment of forensic significance involves estimation of probabilities for determination of probative value. As noted earlier, there are two crucial questions: (1) how likely are the observed results if the samples had a common source; (2) how likely are the observed results if the samples did not have a common source?"

A review of the scientific literature concerning the identification of marijuana utilizing microscopic analysis of cystolithic hairs on the top and bottom of alleged marijuana leaves as well as the chemical test known as the Duquenois-Levine test reveals that we have no idea how likely are the observed results if the samples did or did not have a common source. There has

²¹ Tobin, W.A., Thompson, W.C., *Evaluating and Challenging Forensic Identification Evidence*, in *The Champion*, pp. 12-21 July 2006, National Association of Criminal Defense Lawyers.

not been enough basic research nor has the protocol been properly validated. The Kurzman mystery here is simply how is it that this protocol is still being utilized to decide whether human beings should be confined to cages and, at times, to death chambers?