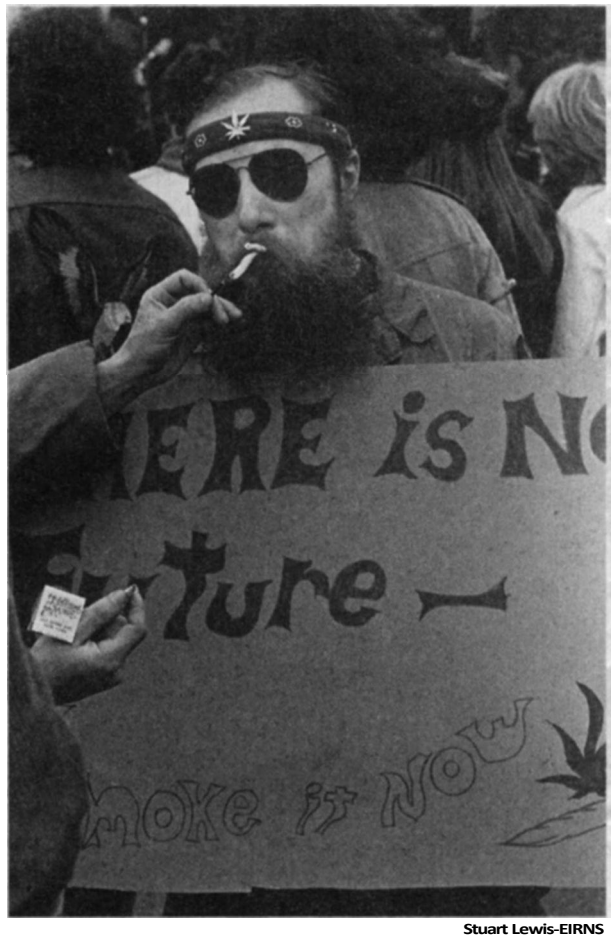
The Medical Effects Of Marijuana Onthe Brain

New research on marijuana confirms that it damages cognitive functioning. Pot legalization would spread this disability.

by Karen Steinherz
and Thomas Vissing



Stuart Lewis-EIRNS

How many victims of the counterculture have suffered cognitive damage from marijuana smoking?

Marijuana is the most widely used illicit drug in the United States and Europe, and tends to be the first illegal drug that teens use. In the United States, it is estimated, conservatively, that more than 5.5 million adults smoke the drug weekly.

Although *Cannabis sativa,* or marijuana, has been in use for at least 4,000 years, it was not until 1964, that Israeli biochemists R. Mechoulam and Y. Gaoni isolated the principal psychoactive ingredient of the marijuana plant: delta-9-tetrahydrocannabinol. Delta-9-THC is the substance in the plant that produces the "high," the feeling of intoxication, that users crave.' The marijuana plant contains more than 400 chemical compounds, of which 60 are cannabinoids—psychoactive compounds that can be extracted from the cannabis plant, or produced within the body after ingestion and metabolism of cannabis.

Here, we analyze the ramifications of some of the most important scientific discoveries about marijuana and its negative impact on the brain. Marijuana can also cause damage to the

lungs and the reproductive system, but that will not be reviewed here. Naturally, the brain is part of, and absolutely dependent on, the functioning of the rest of the organs of the body, for example, for its glucose and oxygen supply. But the brain is in charge of the body; it is the physical substratum of the intelligence, memory, will, and emotion. The human species alone can bring to bear its brain—its intelligence—to change the world around it for better or worse.

Delta-9-THC is found in the resin located mostly in the flowering tops of the plant, with a smaller amount in the leaves, and the least amount in the fibrous stalks. As a result, the psychoactive potency of a cannabis preparation varies enormously, depending on which part of the plant was used to make it. The most powerful form is from the pure resin removed from the leaves and stems; this is known as hashish. Its concentration of delta-9-THC is about 8 to 14 percent. Next in potency is ganja, which is very commonly smoked in the United States. (Unless otherwise stated, we are referring here to the smoked cannabis form of administration, except, of course, in animal experiments.) Ganja is made up of dried plant material taken only from the tops of unpollinated female plants. Known as sinsemilla, this version of marijuana has a THC content of from 4 to 8 percent.[2]

In Holland there are varieties of cannabis for sale with delta-9-THC levels averaging 20 percent, which has led to concern about the high potencies and the resulting psychoactivity. Whether or not the potency levels of other types of cannabis are leveling off in the late 1990s, or are climbing to the levels of Dutch potencies, or beyond, is still an area of much controversy, and the scientific community as well as police forces in the United States and Europe are tracking the issue.

Marijuana Targets the Brain

The principal target of delta-9-THC, as with all drugs of abuse, is the brain, and therefore, researchers concentrated their efforts into investigating the effects of this plant constituent on the body's most important organ.

Cannabis, like nicotine, is normally inhaled, and therefore has rapid access to the blood system. The drug and its metabolites are lipophilic (fat soluble), and thus are easily able to pass through the blood-brain barrier, which controls the passage of many substances into the brain. Even antibiotics, or drugs for cancer treatment, do not cross this barrier; yet, cannabis is able to penetrate the two layers of cells that form the blood-brain barrier. After metabolism in the lungs and liver, into its metabolites, THC moves rapidly to lipid-rich tissues in the body, including the brain.[3]

The user's most common reported feelings under the influence of cannabis are a release from stress, a loosening of associations, and euphoria.[4] It can be a euphoriant, or an excitant, and it can change. As investigators have found, marijuana is dose-dependent, with intoxication most intense for the first two to three hours. The user's past psychological history, his experience with marijuana, and the social setting all play a role in marijuana's influence, in correlation with the drug's chemical complexity and myriad personality effects.

Because THC and its metabolites are fat soluble, they may remain in the fatty tissues of the body for a long time. Later they are released into the bloodstream. There is substantial human variability in the metabolism of cannabis, but it is now proven that individuals who use cannabis daily are more at risk than infrequent users, because of the slow release of THC. The time necessary to clear half the administered dose of THC differs for experienced and inexperienced users, with experienced users accumulating more THC in their systems.[5]

The plant constituent delta-9-THC has been found to produce many characteristic cognitive deficits in both human and animal subjects. It impairs the brain's functioning, particularly with regard to chronic use. Numerous investigations have found that the most pronounced impairments are reduced short-term memory, locomotion disorders, altered time sense, paranoia, fragmentation of thought, and lethargy.[6]

Until 1988, when specific cannabinoid receptors were found in the brain, the mode of cannabinoid action in the human body was not at all clear. There was little biochemical or neurological proof to link these type of behavioral disorders with the actions of specific mechanisms. Pharmaceuticals that mimic THC's effects, called analogues, were not then available for studying the the pharmacological kinetics of marijuana. Because of this lack of conclusive research findings in precisely those areas that establish addiction—that is, the ability of a drug to create dependence and cognitive disorders—marijuana became the subject of much public controversy. The media and the pot legalization lobby labelled marijuana a "soft" drug. By distinguishing it from the opiates—cocaine, alcohol, or the methamphetamines, which are categorized as "hard," or addictive—the legalization lobby minimized the risks of cannabis use.

New Discoveries in an Old Field

Starting in 1988, researchers made new discoveries on the mode of action of marijuana on the biochemical and molecular level. With the help of these findings, marijuana research is in a new, exploratory phase, and scientists are tracking how cannabis consumption specifically alters the physical functioning of the hippocampus, cortex, pituitary gland, and basal ganglia. We caution, however, that most of this research, although extremely useful, assumes a mechanistic view of the brain's functioning.

Marijuana research goes back to the 19th century. The prominent French psychiatrist, Jacques-Joseph Moreau, (1804-1884), is known as the father of modern psychopharmacology. He was the first medical man to do systematic work with drugs active in the central nervous system, and to catalogue, analyze, and record his observations. Moreau wrote the book *Hashish and Mental Alienation* in 1845, and his work is as applicable today as it was then.

Moreau identified the fact that marijuana's effects on the brain were both many and subtle, and therefore not always visible to the naked eye. After observing the acute behavioral changes hashish caused in some of his mental patients at the famous Charenton mental hospital in France, he wrote:

> Yes, unquestionably there are modifications (I do not dare use the word lesion) in the organ that is in charge of mental functions, but these modifications are not those one would generally expect. They will always escape the investigations of the researchers seeking alleged or imagined structural changes. One must not look for particular abnormal changes in either the gross *anatomical or defined histological structure of the brain; but one must*

look for an alteration of its sensibility. That is to say for an irregular, enhanced, diminished, or distorted activity of the specific mechanism upon which depends the performance of mental functions [emphasis added].[7]

The "distorted" activity which Moreau described, are actions that originate from the effects of marijuana on the central nervous system. The human central nervous system contains three major structural components:

• The midbrain and brain stem control basic autonomic responses and the elementary movements associated with locomotion, feeding, and copulation.

• The cortex—the mass of "gray matter" at the top of the mammalian brain, which is substantially larger among primates than other mammals—specializes in complex information processing. In humans, the cortex is the thin uppermost layer of the cerebrum, which consists of two hemispheres. The cortex is associated with verbal language, memory, and the abilities necessary for reading.

• The limbic system, or the third system, consists of structures between the midbrain and cortex, like the amygdala and the hippocampus. In mammals, it is hypothesized that this system is associated with the emergence of emotion and the development of more complex learning and social behavior.

The human brain weighs three to four pounds and contains about 100 billion neurons. These polarized nerve cells receive signals on highly branched extensions of their bodies, called dendrites, and send the information along unbranched extensions, called axons.

There are a multitude of complex physical interactions in the brain. In the conventional view, which is, as noted, mechanistic, communication among neurons is mediated by chemical transmitters that are released at specialized contacts called synapses. The chemical transmitters are called neurotransmitters, and they process the chemical messages that enable brain cells to communicate; the receptors might be thought of as tiny doors on cell surfaces that allow messengers in.

Recent Research Advances

In 1988, William Devane, et al. found a specific cannabinoid receptor in a rat brain[8] and subsequently, the distribution of this receptor in the human brain was mapped.[9] Today, it is generally accepted that cannabis acts on specific cannabinoid receptors in the brain. (Interestingly, the opioids also act through specific receptors.) The cannabis receptors sit on the cell membranes of the nerve cells. In humans, the highest densities of receptors were found in the basal ganglia and the molecular layer of the cerebellum, which is consistent with cannabinoids' interference with movement. Dense binding was also found in parts of the hippocampus, and the dentate gyrus and layers I and VI of the cortex. The latter is consistent with the findings of investigators, over the years, that the pri-

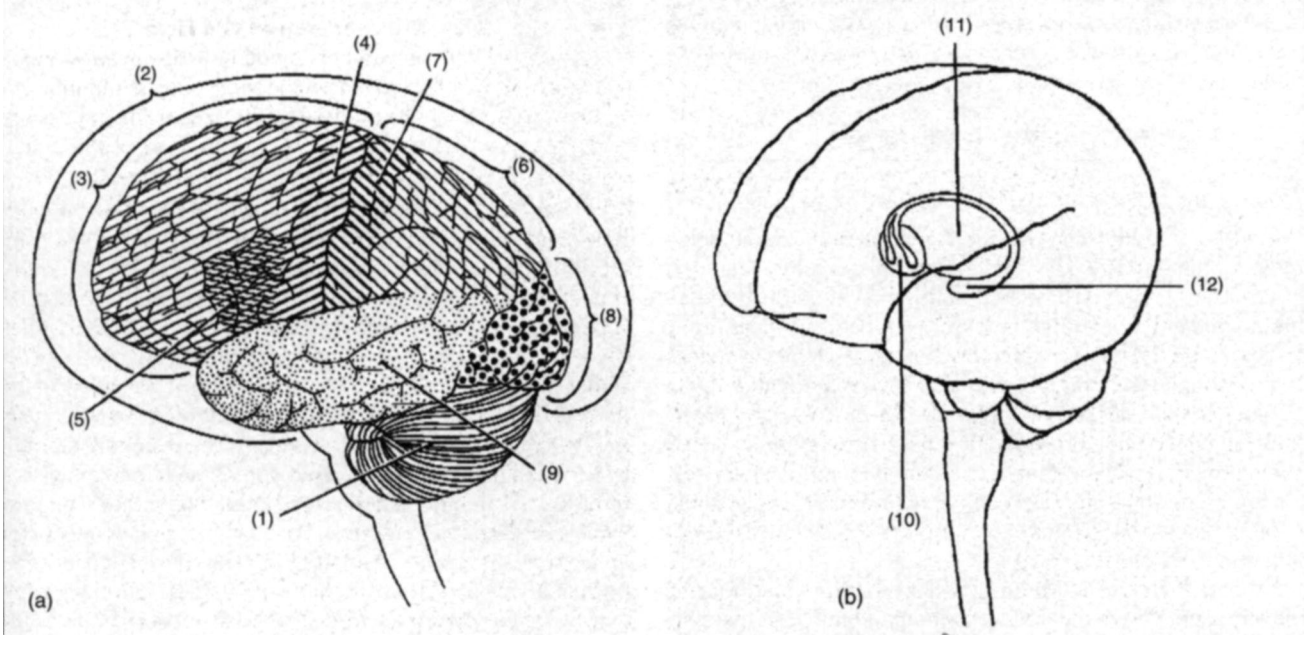


Figure 1
THE ARCHITECTURE OF THE BRAIN

Sketched in (a) are the positions of different parts of the brain: (1) The cerebellum; (2) the cerebrum; (3) the two frontal lobes; (4) a motor area, which helps control voluntary movement; (5) Broca's area, which is related to speech; (6) the parietal lobes; and (7) the primary sensory areas; (8) the occipital lobes; and (9) the temporal lobes. Coating the surface of the cerebrum and the cerebellum is a thin layer of tissue called the cortex, which is commonly known as "gray matter."

The inner brain is sketched in (b): (10) the hypothalamus; (11) the thalamus; and (12) the hippocampus. Cognition is altered by marijuana's impact on the hippocampus.

Source: National Institute of Neurological Disorders and Stroke

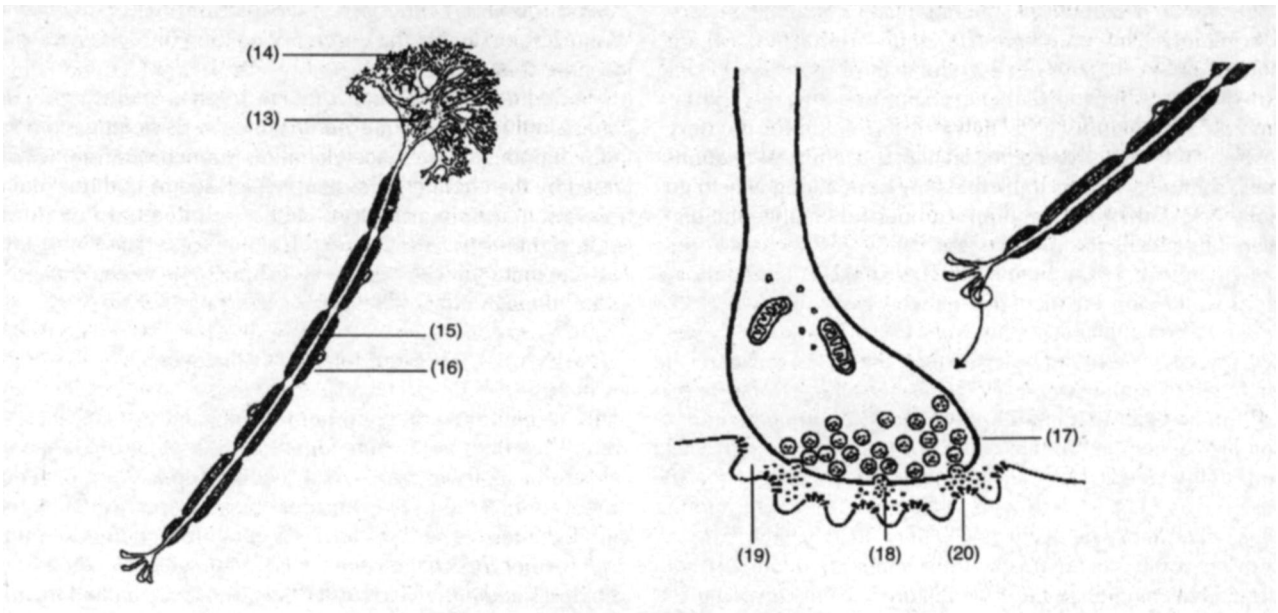


Figure 2
NEURONS AND THEIR COMMUNICATION SYSTEMS

Neurons (a) have three parts: (13) the cell body, which contains the nucleus, where the molecules that the neuron needs to survive and function are manufactured; (14) dendrites, which extend out from the cell body and exchange messages with other nerve cells; (15) axons, through which signals pass from the dendrites through the cell body; and (16) an insulating sheath for the axon.

When a signal reaches the end of the axon, it stimulates tiny sacs (17), which release chemicals known as neurotransmitters (18), into the synapse (19). These neurotransmitters cross the synapse and attach to receptors (20) on a neighboring cell.

Source: National Institute ol Neurological Disorders and Stroke

mary effects of marijuana were on the cognitive faculties.

In 1990, Lisa Matsuda provided conclusive evidence documenting the damage of marijuana on the cognitive faculties, after cloning a gene for the cannabinoid receptor in the rat brain which, in collaboration with M. Herkenham, was found to be 97 percent identical with the human receptor.[10] Interestingly enough, the cannabis receptor was also located in the nervous system of lower vertebrates like chickens, and even trout, suggesting that the gene must have been present early in evolution. The conservation of this gene implies that the receptor serves an important biological function in the body. Later, another receptor was found, in the spleen, and still a third was found in the uterus."

Naturally, the rodent brain, or that of any animal, for that matter, cannot be compared to the human brain. But there are many effects, such as the impact of cannabis on movement, that are easier to evaluate with animals, because it is possible to maintain tight control over laboratory conditions, doses, and animal history. Investigators then project these results onto humans, making enormous qualitative allowances for the species differentiation of the brain.

In 1992, another crucial discovery was made. William Devane and Raphael Mechoulam, working at Hebrew University in Israel, pinpointed a naturally occurring brain molecule, anandamide, that binds to the cannabis receptor and creates a "high" similar to that of marijuana. Anandamide is a compound derived from fatty-acid, which possesses pharmacological properties similar to those of delta-9-THC. This would indicate that smoked marijuana operates through a specific biochemical system that already exists in the body. If receptors for exogenously supplied substances exist, then there must also exist corresponding chemically related substances, which occur naturally in the body, and are very similar.[12] The anandamide is found particularly in the hippocampus, the thalamus, and in the cortex structures of the brain.

Although these two discoveries contribute to our knowledge of how cannabinoid action works in the body, they also raise some puzzling new questions. For example, in laboratory rats, anandamide was shown nor to have the same strength of effect on spatial memory in rats as did delta-9-THC. Does this mean that the naturally produced cannabis, the anandamide, is different from smoked cannabis? And if so, why? What, then, is the purpose of anandamide? Under what conditions is anandamide released? Scientists are now trying to figure out the actual function of this system.[13] Surely it does not exist in the body so that humans could smoke marijuana.

Short-term Memory Damage

In a useful review of the scientific literature, conducted in 1983 by Miller and Branconnier, they found that the most consistently reported cognitive deficits from chronic marijuana smoking were memory deficits.[14] Scientists today consistently

voice concern over the effects of marijuana smoking on short-term memory. Physically, it is the hippocampus in the brain where researchers locate the series of actions that converts information into short-term memory, and perhaps, also, long-term episodic memory and "gates" information for memory consolidation, as well as coding spatial and temporal relations among stimuli. Scientists think that they have a long way to go before they understand the hippocampus fully. Since the discovery of the cannabinoid receptor family, researchers know that high numbers of cannabinoid receptors exist in this structure, as well as the anandamide.

How human memory literally goes up in marijuana smoke, by its medium- and longer-term effects on the hippocampus, was graphically described by Professor Samuel Deadwyler from the Bowman Gray School of Medicine in North Carolina, in a speech at the 1995 National Conference on Marijuana Use, sponsored by the National Institute of Drug Abuse:

> It is this area, when damaged, that renders patients literally incapable of remembering new information for more than a few minutes and is *undoubtedly critically involved in the well-known memory deficits in Alzheimer's disease.* When these hippocampal marijuana receptors are stimulated, they have the effect of rendering the hippocampus inactive.
>
> Long term exposure to marijuana has dual consequences for the memory. First, repeated exposure to marijuana in animals makes them more and more tolerant of this memory disruptive effect. However, this also means that continued use of the drug requires higher and higher doses before the euphoric or high state is achieved. Hence, even though memory is not impaired at the same dose as before, it will be impaired just as much because the individual will take more drugs to obtain the original euphoric state. What this means is that chronic use will eventually produce permanent effect on memory since the hippocampus will adjust its memory storage mechanisms to handle the lower capacity or volume of information flow produced by the drug. Thus, even when the drug is not present, *the hippocampus will be altered and reduced in capacity to perform at optimum level.* This may be the basis for the well-known memory deficits that are present in chronic marijuana users lemphasis added].[15]

Deadwyler and his associates have been preoccupied, for at least 10 years, with obtaining more detailed information on how this structure actually works. Deadwyler found that delta-9-THC selectively suppresses hippocampal electrical cellular activity in rats. He also located the fact that the granule cells provide a critical link between the entorhinal cortex and the hippocampus. Another scientist, K.A. Campbell, found in 1986 that the dentate gyrus, an area of the hippocampus, has its sensory decoding disrupted by THC.'[5]

Neural pathways are conventionally thought of as electrical circuits, either parallel or serial. Understanding the brain's organization of the cannabinoid circuitry and its relation to other brain circuitry, not only could help to elucidate the function of the body's cannabinoid system, but also could give us more specific data on the workings of the hippocampus, and memory itself.

Such research is ongoing. Dr. Billy Martin's laboratory in Virginia, for example, has been researching the effects of THC for more than 20 years. Recently, Martin and Lichtman have presented data showing, for example, that cholinergic and cannabinoid receptors are *not* in series in disrupting memory in the hippocampus.[17] Acetylcholine is a neurotransmitter released by the cholinergic system, which seems to direct attention and maintain attention. Higher intellectual functions, such as memory and learning, require controlled attention. The fact that both cholinergic and cannabinoid receptors exist in the hippocampus, and in other brain areas associated with memory, would suggest the possibility that these two neural pathways work together, but how this happens is still not understood.

Brain scientists freely admit there is still much uncertainty about the operations of the hippocampus; for example, consciousness is possible even when the hippocampus is removed. But, as one researcher stresses, one crucial thing is certain: Long-term and short-term memory survive such a lesion "but *transfer from the former to the latter becomes impossible* [emphasis added]."[18] No matter how one looks at the function of memory, it is obvious that man needs his hippocampus. Children and young adults, in particular, depend on their short-term memory, since they are learning and receiving new input constantly.

In addition, the hippocampus is dependent on information processing and input from other brain areas that are affected by cannabis smoking. For example, there are many cannabinoid receptors on the cerebellum. The cerebellum processes information which is largely related to motor function. The frontal lobes, which process temporal relations, also have cannabinoid receptors. Given the number of regions of the brain that are affected, this means that, ultimately, the entire brain, and the entire body, will be affected.

The cognitive drawbacks of cannabis-caused impairment are not inconsequential. They affect driving a car, operating a plane, or employing a complicated piece of machinery. In such skilled activities, one's undivided attention, recall, quick visual-spatial mapping, and split-second timing, are required at every second.'[19] Or to take a simpler example, what about the young adult who is attempting to learn how to play the trumpet. How can the student who has smoked too much marijuana simultaneously have command over the complex processes required to perform a piece of music—memory, coordination of hands and mouth, emotion, and interpretation?

The Neuroendocrine System and Cannabis

Another important aspect of brain and long-term effects of chronic cannabis use is its effect on the hippocampus and its hormone system. Researchers).C. Eldridge and P.W. Landfield are studying the relationship between the glucocorticoid receptor system in the hippocampus, and chronic cannabis use. Glucocorticoid, is a steroid that is secreted in times of stress. They write:

> Chronic THC administration induced aging-like degenerative changes in the rat brain that resembled . . . the effects of stress exposure and elevated corticosterone secretion.[20]

Argonne National Laboratory

A research team headed by Dr. Eliezer Huberman, at Argonne National Laboratory, has shown that active ingredients in marijuana, THC and related cannabinoids, keep blood cells from maturing, thereby reducing the body's ability to fight disease. Here, Huberman (left) examines a protein map that reveals the individual proteins in blood.

Eldridge and Landfeld's work was conducted before the discovery of anandamide, so that they did not have the benefit of knowledge of the cannabis "lock." Nevertheless, their work on the interactions of marijuana with the hormone system of the body is very useful, for hormones play a central role in regulating the body's reaction to stress, and because marijuana is used ostensibly to relieve stressful situations.

The importance of hormones can be seen in looking at the effects of cannabinoids on pituitary hormone secretion. The pituitary gland secretes eight different hormones that play crucial roles in regulating metabolic and reproductive functions throughout the body. The adrenocorticotropin hormone (ACTH) is released in response to stress. The thyroid stimulating hormone (TSH), and the growth hormone (GH), are important in the maintenance of metabolism. Studies indicate that chronic and acute use of marijuana may have an effect on the reproductive system and the individual's ability to respond to different metabolic changes and stress.[21] Some researchers also believe that too little stress is unhealthful for the brain, for then the brain is not in gear.

Biophysical Clues

Today, most scientists study how cannabis affects cells by chemical and electrical methods of examining neurons in the brain. In this method of investigation, scientists identify how membranes and proteins interact. Proteins are a large family of biological molecules, which are made by stringing amino acids together to form long chains. There are many kinds of proteins; they are the "machine tools" of the cell. Enzymes, for example, are made of protein, as are the ion channels that move ions across cell membranes. It is the movement of ions across cell membranes which is conventionally thought to be the main method for electrical signalling in the brain.

There have been many experiments on understanding the electrochemistry of the 9-delta-THC molecule, and the pharmacological kinetics of the THC-cell receptor bindings. Also, much has been done on non-receptor membrane interactions with cannabis.[22] Naturally, after the post-1988 discoveries of the cannabinoid receptors, the cannabis receptor and linked anandamide research became the most logical, and fruitful, method of investigation.

However, another avenue for examining how the psychoactive substances of cannabis, the cannabinoids, work is to perform biophysical experiments and measurements, looking at the physical interactions between the drug and the part of a living cell it targets, on a microphysical scale. This method has promising results for investigations of the medium- and long-term effects of cannabis on the brain and nervous system. The biophysical method of investigation asks different questions about cells than does the biochemical avenue. For example, are there changes in the physical state of a membrane that correlate with how THC molecules behave?

A few words about the importance of the membrane. Each cell is surrounded by a double layer of lipid, called the lipid bilayer. Lipid is a name for certain organic molecules that have one water-attracting end, and one fat-attracting end. A typical cell membrane is about 5 nanometers thick, compared to a cell dimension of 1 to several micrometers in cross-section. (If the inside of a cell were scaled up to be as large as a big living room, the cell membrane would still be only a couple of centimeters in thickness.)[23]

Traditionally, one can think of a cell as being like a well-organized city, which contains water and different organelles, including the DNA, as the chemistry takes its course. The cell itself is full of membranes, because many parts of the cell have a surrounding frame, or bilayer. The nucleus, and the golgi apparatus, for example, are surrounded by a membrane. Thus, most biological processes have to interact with membranes. Phosphocholines (DPPC) are the main constituents of biological membranes; other constituents include the sterols and cholesterol.

Alexandras Makriyannis and colleagues, working at the University of Connecticut at Storrs, have been doing biophysical work with cannabis, for some time, in collaboration with other institutions. Synthetic membranes can be made very simply by dispensing lipid molecules in aqueous solutions. Using such model membranes is extremely useful, because it is possible to ask simple questions and have control over the physical properties. The Makriyannis group added THC molecules in varying concentrations to the model membranes, and then applied different spectroscopic techniques in order to measure the change induced by THC.

Another technique this group used is called differential scanning calorimetry, which makes use of the coupling between the temperature and the phase transition of a lipid bilayer. By using different analogs of the principal active ingredient, the delta-9-THC, in mixing with the model membrane DPPC, the Makriyannis group found that the gel states disappeared; they also found that the gel-to-fluid change was different when active THC-analogs were increased.[24]

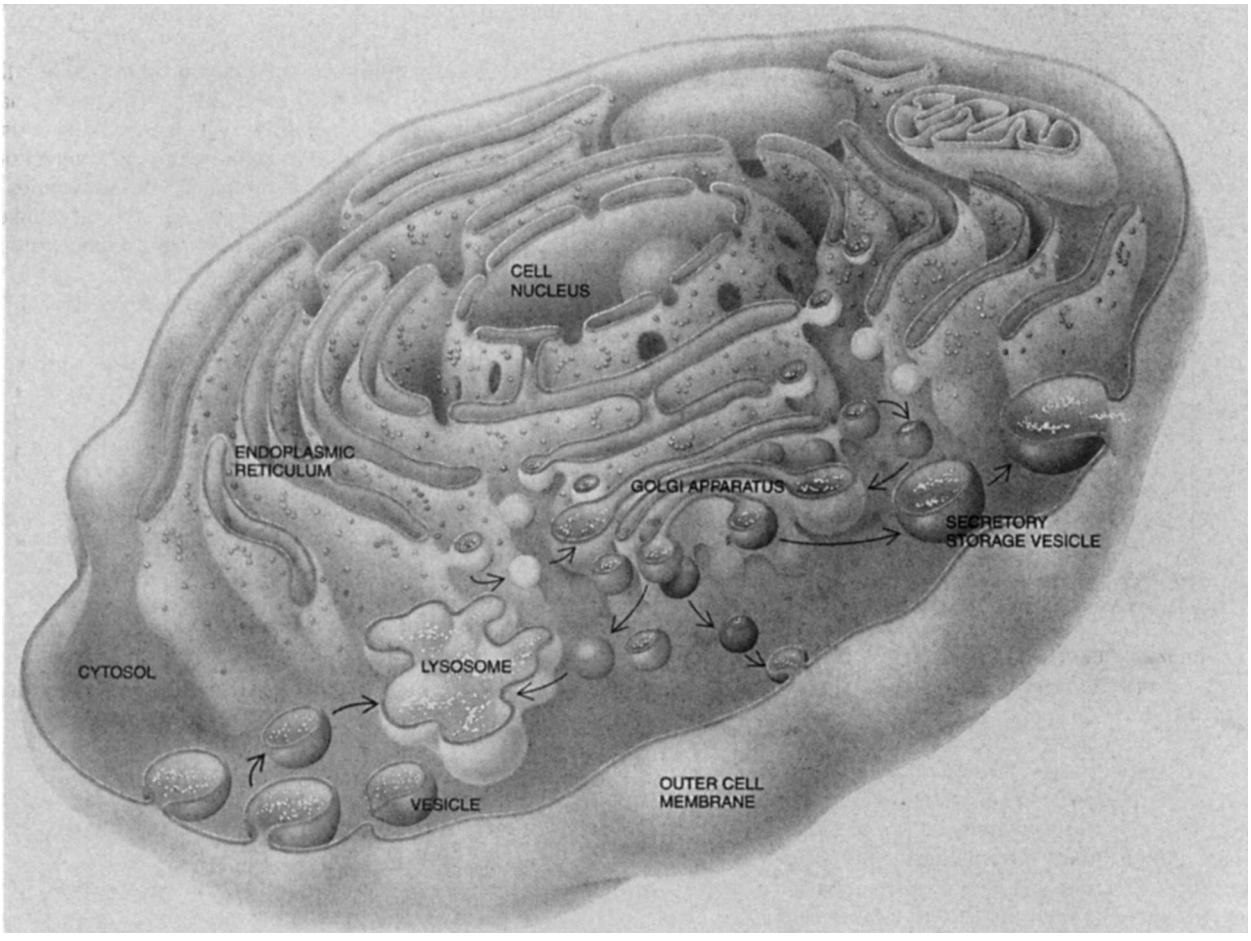


Figure 3
TRANSPORT VESICLES IN THE CELL

The cell is like a well-organized city. This artist's illustration shows the various transport vesicles in a cell. Some convey proteins made in the endoplasmic reticulum to the Golgi apparatus, which modifies the proteins. Others transport proteins and enzymes in and out of the cells, or store them. Scientists have found that the THC cannabinoid causes subtle changes in cell processes.

Source: Tomo Narasnima/*Scientific American*

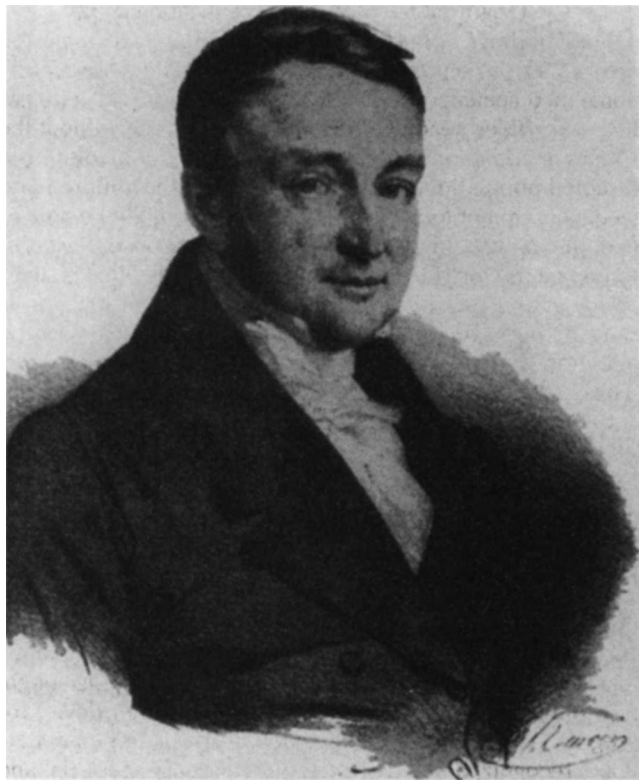
A lipid bilayer has the ability to change between different physical states, which is important for biological processes in the cell. The fact that THC causes these tiny changes is significant, because of the physical dependence of cellular membrane structure on biological activity. It also points to the potential influence of THC as a membrane "perturber," with implications, ultimately, for the brain and the entire body.

Although the cannabinoid receptors and anandamide, have been identified—that is, there is a specific biochemical system for cannabis's psychoactive effects to be pharmacologically set into motion—this biophysical approach should not be abandoned. According to Mavromoustakos and Makriyannis, et al., it appears that not all the impacts on the body from cannabis smoking are cannabinoid-receptor related. As proof of this, for example, the researchers cite the impact of cannabinoids on neurotransmitter uptake systems and on blood platelets.[25] And researchers have admitted that chronic cannabis users may have symptoms even in the long-term and non-intoxicated state, long after cannabis is no longer detectable in the blood or fat.[26] Perhaps in the future, membrane research could explain some of these phenomena.

The overriding consideration here is that the entire brain and the entire body depend on each other and operate together. We cannot underestimate the impact, sometime in the future, of subtle effects such as those Moreau noted in the 19th century, which have their origin in tiny microphysical changes in the brain's substratum. Moreau once referred to this phenomenon as a "molecular disintegration" of personality, which is what we will next examine.

Marijuana As a Personality 'Agent Provocateur'

So far we looked at some individual structures of the brain and then at the microphysical level. Putting the head back on top of the person's body, now we might ask, how does the mind of an individual under cannabis's influence actually work? And what are the visible signs of this in the person's behavior?



jacques-joseph Moreau (1804-1884), a prominent French psychiatrist, was the first medical man to do systematic work with drugs active in the central nervous system, and to catalogue, analyze, and record his observations. His 1845 book, Hashish and Mental Alienation, *is still applicable today. Moreau termed marijuana a personality "agent provocateur."*

The psychiatrist Moreau tested cannabis not only on his patients, but also on himself and his colleagues in the literary circle, Le Club des Hachichins. In fact, Moreau administered doses far exceeding that which any scientist today would be allowed to use. Without any government restrictions, Moreau dared to use up to 16 grams! When one reads his results, therefore, one has to be careful about the interrelationship between the high dose of which he is speaking, and the pre-existing mental state of his subject. Nevertheless Moreau's observations are still relevant.

As did later researchers, Moreau discovered in his experiments during the 1800s, that marijuana's effects are dose dependent. If the dose was high enough and the use chronic, Moreau observed that his subjects often became insane. With the administration of lower doses, Moreau identified long-term personality changes that were more subtle, including shortened attention span, distractability, and a progressive loss of mental powers. Moreau did not view the progressive destruction of the individual's mental powers, under the chronic use of marijuana, as simply a linear addition of one more cognitive deficit in a human performance test. He stated that any individual under the chronic use of marijuana was "mentally disturbed." Moreau wrote, based on his observations and scientific knowledge, that by destroying the unity of thought in the individual, that individual was mentally ill, even if he did not look like, or act like, a psychotic. Moreau did not think one could automatically see this devolution in the initial stages with the naked eye:

> Such are all, or almost all, the physical disorders caused by hashish from the weakest to the most intense. One sees that they all relate to the nervous system. As we have already said, they develop much more slowly than the mental disturbance, *and the mind can be profoundly changed without affecting the body. It seems that the causal factor* [that is, the drug] *acts directly on the faculties of the mind without the mediation of the organs, as in the case of mental illness* lemphasis added].[27]

Moreau identified how the mind is destroyed from marijuana smoking, notably through distractability:

> One of the first measurable effects of hashish is the gradual weakening of the power to direct thoughts at will. We feel slowly overwhelmed by strange ideas unrelated to the subject on which we are trying to focus our attention. These ideas, which we have not willfully summoned in our mind, appear at random and become more and more numerous, lively, and keen. Soon they command more attention and generate bizarre associations and fantastic creations. If by an effort of will we resume the sequence of our ideas, the ones we have rejected still echo in our mind, but as if from a far-away distance muffled like dreams of a restless night. . . . |T]hese ideas, or rather this series of ideas, are actually dreams, "true dreams" in the strictest sense. One cannot distinguish them from those created by natural sleep. . . . You forget those things which at present most excite your interest and stir your passions, which absorb all your attention, to dream only those which were in the past.

A little further on, Moreau summarized this process, stating, "The action of hashish weakens the will—the mental power that rules ideas and associates and connects them together."[28]

Moreau's observations find frequent corroboration today. A comprehensive paper, "Effects of Smoked Marijuana on Human Performance: A Critical Review," by investigators L.D. Chaitt and). Pierri in 1992, reviewed and analyzed many years of marijuana investigations on human beings. In addition to the well-known short-term memory deficits from cannabis usage, these researchers found that another reported result of the human studies were frequent memory intrusions.[29] (Memory intrusions are stimuli listed by the test subjects that are not actually present.) Also, they found reports of significant effects on time estimation. One of the researchers they cite, Nadaia Solowij, a cognitive scientist in Australia, recorded such memory intrusions, among other observations. She postulated that chronic use of cannabis might account for this, by creating long-term changes at the cannabinoid receptor.[30]

If Moreau were alive today he would probably say that the individuals in these studies have an "agent provocateur," a term he coined for the effects of marijuana upon the nervous system. Slowly, subtly, the will of the person is being undermined.

Psychological Predisposition?

Professor Ann Pollinger Hass, who works at the City University of New York, studied 300 marijuana users over six years, and found that the motivation for taking marijuana was that the drug helped to suppress intense anger. As she wrote,

> Chronic use allowed these youngsters to withdraw from conflicts about achievement and competition. It was used to encourage grandiose expectations, feelings of invulnerability, and a sense that a magical transformation of their life was possible.[31]

The question arises, is the marijuana reinforcing a *pre-existing* lack of self-esteem, or infantilism? Among such researchers, there is a heated discussion about whether cannabis use induces psychosis, or whether the person who uses the drug has a psychological predisposition that drew them to drug use in the first place?[32] In any case, as Moreau pointed out, the drug itself can activate mental problems. However, this question of what came first, psychological pressure or the cannabis, is used by the pot legalization lobby to deny that marijuana is the cause of teen problems.

We live in a society where the popular culture advertises that marijuana is relatively harmless. Because of the breakup of the family, the destruction of traditional institutions and values, and the ordinary pressures of adolescence, teenagers have their attention easily drawn to drugs as an easy and pleasurable way out of conflict, or any difficulty. Marijuana is also America's number one cash crop, so it is certainly easy enough to find.[33] Given this situation, it is all the more reason to keep marijuana illegal.

What about the children of marijuana users? Professor Peter Fried has found in preliminary work that children between 9 and a half years old to 12 years of age suffered from a deficit in what researchers term "executive function," a type of cognitive intelligence involving planning for both the present and the future. In his tightly controlled study, children of 120 marijuana-smoking mothers were evaluated on a regular basis from birth. These children were found to have problems in focussing their attention, and were highly distractable. Fried summarized the situation of the mothers as follows:

> [T]here is a lot of evidence to suggest that marijuana has a tremendous impact on the prefrontal lobe and functioning associated with that part of the brain in marijuana users. In addition, the prefrontal area in animals is one of the areas of the brain where there is a high concentration of cannabinoid receptors.[34]

Researchers are currently working on questions such as, how cannabis can be transferred through the mothers—is it through the milk during lactation, or through the placental blood during gestation? How is the nervous system of the developing child altered when the mother smokes? Is the children's diminished learning ability in adulthood based on prenatal and perinatal exposure to delta-9-THC? Although this research is far from complete, it certainly poses interesting challenges for marijuana research—as well as life and death questions about drug abuse for developmental embryologists.

The Origins of the Marijuana Legalization Lobby

If the findings of Professor Fried and others are accurate, then society is confronted with the reality of an inter-generational incompetency caused by smoked marijuana. A population with widespread addiction to hashish, even without the spread of addiction from heroin or cocaine, or alcohol, is a disabled population. In any society where the children and teenagers cannot focus their attention, they might be able to perform boring or low-skilled jobs, such as fast-food service, or running a microchip computer. But their "will," that is, their energies and curiosity to look outside their infantilism, is sapped. These young adults will not have the interest, or the attention span, to develop the economic and cultural well-being of the country in which they are citizens.

But this egregious outcome is exactly what motivates the pro-pot lobby that is pushing the legalization of marijuana today. Their legalization agenda is based on the "India model," an elaborate tax system that the British imposed on the population of India in 1895, in the height of the era when "the Sun never set on the British Empire."

A brief look at the history of how the British Empire used drugs to subjugate populations, and at the same time make easy fortunes, makes it clear that while the colonialists wanted to destroy development and progress, their opponents fought to prohibit psychotropic drugs because of their desire for progress. The individuals and countries that fought to outlaw dope, recognized that a nation could not have industrial and social progress *and* rampant drug usage. Progress and drugs are incompatible.

In 1893, the British Parliament commissioned what turned into a nine-volume study on hemp-growing in India, then a British colony. The India Hemp Commission Report, which took more than two years to compile, was an elaborate justification of an extensive hemp (marijuana) tax system, and the continued subjugation of the coolie population by encouraging its use of ganja.

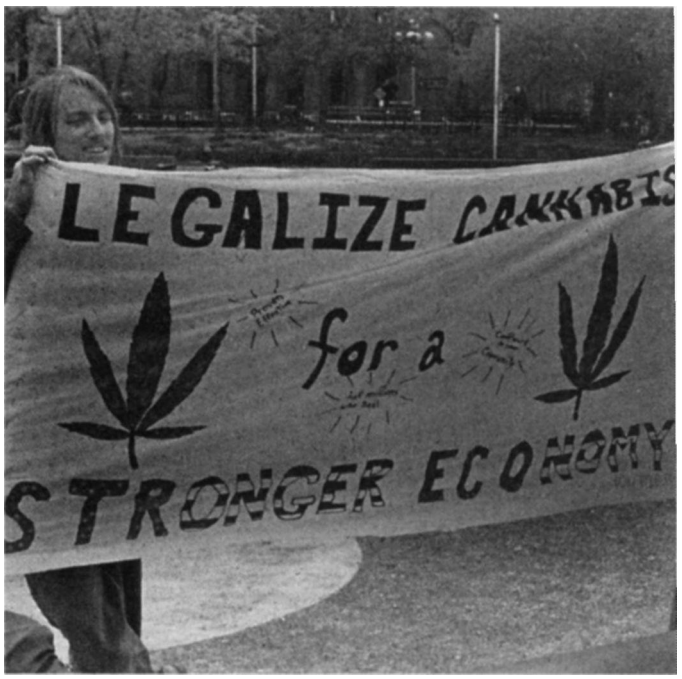
In the same way that the British opium trade in China was used in the Opium Wars of the mid-19th century to turn China into a drugged nation, incapable of acting in its own interest, the legalization of ganja was a convenient method for suppressing the population of India. The 1893 report is more than history. According to spokesmen for the National Organization for the Reform of Marijuana Laws, known as NORML, this Hemp Commission report is being used by NORML today as a model for its legalization argument!

It's easy to see why NORML is pushing this report, if we look at some of the testimony in the 1893 report, taken from pro-marijuana witnesses at the time, many of them plantation owners and tax collectors:

- Mr. Skinner, manager, Corga Tea Company, Tezpur, Darrang, India, witness for the report: "The castes who use it most are Yoosoahe from Gaya . . . bricklayers from Calcutta, and of the jungle caste such as the Munhas and Sonthals. . . . I cannot see any harm in the use of the drug. All of those who appear to use it are good, quiet, and willing coolies . . . with no deleterious effects.. .
- Mr. John Phillips, tea planter, witness for the report: "I advocate no prohibition on ganja.... If prohibited, the health of our coolies would suffer, their lives would be sacrificed, and of course, discontent would ensue."

Walter Bird

The mother of today's international pot lobby: Baroness Barbara Frances Wootton of Abinger. For almost 60 years, Lady Wootton was a key figure in shaping New Age social policies, and her Wootton Committee report is the founding document of today's international pot lobby.



Stuart Lewis/EIRNS

The pot legalizers propagandize that marijuana relieves pain and stress, and has no harmful effects. What they don't tell you, is that when your brain goes up in smoke, you become a good coolie in their Brave New World.

• Rev. J.P. Jones, an Anglican missionary in Sylhet, witness for the report: "I have heard of men giving a few pence to buy ganja for boatmen and others where they require a little extra work from them."

• Deputy Commissioner of the port, Akyar, witness for the report: "It [ganja] is now brought in by the British India Steam Navigation Company.*[35]

The next British report to take on an important role in the pot legalization movement is that of the first official commission in the world to explicitly recommend the removal of criminal penalties for marijuana possession—a 1968 committee of the British Parliament, chaired by the Baroness Barbara Frances Wootton of Abinger. The so-called Wootton Committee report is the founding document of today's international pot lobby.[36] Lady Wootton, a former Deputy Speaker of the House of Lords, may not be well known, but for almost 60 years she was a key figure in shaping the kinds of social policies that could turn the United States into a version of Aldous Huxley's *Brave New World.*

Wootton's top assistant on the committee, Michael Schofield, a Cambridge University social scientist, filed a "dissenting opinion" on the committee, calling for full cannabis legalization. Later, he sat on the governing board of the Legalize Cannabis Campaign in London. In the words of Schofield himself, the choice is between a moral society dedicated to industrial progress, and a brave new world. Schofield writes in his book, *The Strange Case of Pot:*

> There has been a growing emphasis on the cultivation of aesthetic and mildly hedonistic sensibilities. This is in line with current economic trends. Before long, working hours will become shorter and less important. The old puritan ethic which glorified work for its own sake will be less meaningful and leisure activities will become more important. . . . In such an atmosphere, the boundaries of permissible pleasure are extended and experimentation is encouraged. The use of cannabis to produce new sensory stimulation is a logical development of this ethic. . . . Of course there is no such thing as an ideal recreational drug. Cannabis like every other legal or illegal drugs falls far short of the ideal. . . . The ideal recreational drugs would make us feel relaxed and happy and act as a social lubricant. . . . Soma, the fictional drug in Aldous Huxley's *Brave New World gave* great pleasure harmlessly.. . . We have not (yet) come to terms with the idea of recreational drugs and so we cannot start to think out attitudes towards chemical aids to pleasure. Until we have developed a social philosophy, we are unable to make intelligent judgments about their use and abuse.

Today, the Brave New World is here. Increasing numbers of youth, and their parents, who were the "flower children" of the 1960s, suffer the effects of drug use, while the pro-pot lobby, and its political and financial backers, try to engineer more "soft" drug use as a method of controlling the "coolies" of the 20th and 21 st centuries. The coherence of the current legalization campaign with the motivation behind Britain's past Opium Wars and the Hemp Tax are not altogether lost on the thinking public. Recently, for example, an op ed in the newspaper of the state of Hessen in Germany, by Dr. Jacqueline Kempfer, attacked the Social Democratic government of the north German

state of Schleswig-Holstein for its plan to sell marijuana over the pharmacy counter.[37] Kempfer attacked both the anti-industrial Green party and the Social Democratic Party of Germany for eliminating nuclear energy in their states and hence lowering the living standard and creating unemployment. Then she charged that SPD Health, Work, and Social Minister Heide Moser was abusing her position as Minister for Health by leading the so-called hash initiative, stating:

> Maybe the hash experiment is the . . . solution for our actual problems. When we are filled with dope, unemployment seems much less, the Euro Icurrency designed by the European Union's Maastricht Treaty to replace the deutschemark) seems more valuable, our pensions are safer, and the taxes appear less.

The challenge worldwide is whether those citizens whose brains have not yet gone up in marijuana smoke, will fight to defeat NORML, financier-speculator George Soros, and the other organizations and individuals who are propagandizing for the legalization of "soft" marijuana for the coolies of the 21st century.

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