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PSYCHOTOXIC OR PSYCHEDELIC?

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The current epidemic of drug abuse in the search for means to alter consciousness is only one of the many ways of altering or transcending states of awareness (1, 2).¹ Many other spiritual exercises in religion, hypnosis, parachute jumping, or rock climbing are a few of the possible examples of the ways known to alter mood and thought and orientation. In the search for the effects of the psychedelic drug "trips," many substances have been explored—nutmeg, furniture polish, aerosol freezers, airplane glue, and other bizarre agents. The word, "psychedelic," coined by Osmond (5) reifies the "mind-manifesting" process known for millenia and grants a new prestige and a scientific aura for what is a psychotoxic process. Man has inhaled carbonated air emitted from the earth, rotated thongs in the pectoral muscles until they wore out. Yoga, with its transcendental meditation techniques, was an attempt to achieve the psychedelic state. Zen Buddhism is construed as a path for "turning-out" without drugs (3). DeRopp (4) devised a parlor game which describes a "pathway to Higher Consciousness Beyond the Drug Experience." Schizophrenics may experience biochemical changes which many of the psychotomimetic drugs are presumed to model. Respiratory failure (anoxia) due to lack of oxygen in body circulation may cause hallucination and so will electric stimulation (6).

Osmond (5) originally sought a word in 1957 to

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¹Numbers in parentheses refer to references following this article.

replace "psychotomimetic" with one which would be "euphonious" and not connote a sick mind but expand and open the mind to man's own nature to increase his understanding and awareness. He indicated that specific beneficial goals could be reached by "unhabitual perception" through psychedelic drugs. The word "psychedelic" was to imply good and beneficial effects . . . from the use of compounds like LSD.

LSD was an accidental discovery of an extraordinary sort. Its profound and specific hallucinogenic action led to eager research in many laboratories in hope that such studies with psychotomimetics would elucidate the psychotic processes. It led also to a popular mechanics and popular medicine by those not qualified. Too many young people have played with the physical and psychological effects with no capacity to control or evaluate the experience and its consequence.

While LSD has not been found to be lethal, its uncontrolled use has subverted many individuals, and has created an abusiveness in which meaningful research into its potentials as a psychotherapeutic agent is not possible.

The popular cult of psychedelia has been exploited by the mass media to embrace an antimonian ideology and hair styles, jewelry, and argot. The ingestion of the drug is only one aspect of the transvaluation of values and a reorientation of the individual who seeks to vitalize his life anew.

Tolan and Linge (6) have compared the syndrome of toxic psychosis due to gasoline inhalation with the so-called "model psychosis" evoked by mescaline, LSD, and psilocybin. These "psychotomimetic effects" have also been observed by

Press and Done (7) in deliberate toluene inhalation. Visual hallucination and euphoria are among the desired effects sought by glue-sniffers, and these subjective responses have been noted in a large number of medical case reports.

What criteria must a substance fulfill psychopharmacologically to be called a psychedelic? Is "psychedelic" a valid differentiation scientifically merited or is it merely a public relation labelling operation? It appears worthwhile to examine some of the terms used interchangeably. While hallucinogens² include only those drugs which produce hallucinations, a more general term describing a whole range of toxic effects on the cerebrum are called psychotoxic or psychotogenic. These may not only include "trips" accommodated by the exogenous drugs such as mescaline, LSD, Cannabis, and barbiturates, but also by a wide range of anesthetics and commercial organic solvents. A lack of air and water in toxic amounts may also be considered psychotoxic.

In comparison to the terms psychotoxic and psychotogenic, the terms psychotropic and psychoactive have also been used to cover the spectrum of drugs and chemicals having an affinity for cerebral processes without invidious inferences.

"Psychotomimetics" was introduced by Gerard (9) and applied to those agents reproducing characteristics of functional psychosis. To be classed as a psychotomimetic, the drug must only mimic the syndromes of a psychiatric illness and "its action must be both readily reversible and of limited duration" (10).

Psychotomimetic agents have been described as being capable of effecting changes in perception, emotion, thought, and ego function (11). These changes are differentiated from the deliriant effects elicited by alcohol, morphine, cocaine, and atropines since these latter compounds tend to cloud consciousness and exhibits other serious disability of the autonomic nervous system (12); the definition of psychotomimetics therefore also excludes anesthetics, analgesics, and hypnotics. Ilett and Parfitt (13) categorized the psychotomimetics into four groups: phenylethylamines, (e.g., mescaline), indoles (e.g., LSD, bufotenine), piperidines (e.g., phenycyclidine), and cannabinols (for marijuana).

² See Comprehensive Drug Abuse Prevention and Control Act of 1970, 21 U.S.C. §§801-966 (1970), in which 17 hallucinogens, including LSD, mescaline, marijuana, MDA, DMT, psilocybin, are specifically listed as controlled drugs.

Osmond (14) defined psychedelic as a compound "like LSD or mescaline which enriches the mind and enlarges the vision. It is this kind of experience which provides the greatest possibility for examining those areas to psychiatry and which has provided men down the ages with experiences they have considered valuable above all others." While psychotomimetic refers to psychological changes resembling, more or less, experiences like those found in psychotic illnesses, psychedelic implies a beneficial change and the description of a positive value; however, the word tells more about attitudes towards drugs than about the effect of the substance.

The net effect from LSD trips, after all the confusional experiences have been swept away, has not elicited any profound revelation. The overt behavioral change produced by LSD trips appears to be minimal or non-existent in most cases. A variety of bizarre, subjective experiences has been described, but there appears to be no new insight or true revelations.

PHARMACOLOGICAL BASIS OF COMPARISON

Since its discovery by Hofmann in 1943, LSD (lysergic acid diethylamide) has remained the chemical vehicle for "model psychosis." Its effects have been used as a basis for comparison with other substances producing potentials for causing "conscious alteration."

LSD belongs to a group of substituted indole alkylamines. Others in the group include such psychotomimetics as dimethyltryptamine (DMT), diethyltryptamine (DET), bufotenine, psilocin, psilocybin, harmine, and ibogaine. Current reviews by Hofmann (12) Hoffer and Osmond (14), Downing (15, 16), Crossland (17), Jacobson (18), and Cohen (11) more than adequately cover the chemistry and pharmacology of LSD and other indole hallucinogens.

A cursory examination of the basic structure of these compounds would reveal their amazing similarity to serotonin, or 5-hydroxytryptamine (Fig. 1), an endogenous chemical putatively called an "inhibitory transmitter" acting between nerve cells. The presence of serotonin has been theorized to suppress the brain cells from becoming over-excited and resulting in hallucination and other behavioral aberrations.

The specificity of LSD compounds at the nerve receptor sites introduces another dimensional interest to the above hypothesis. The brominated

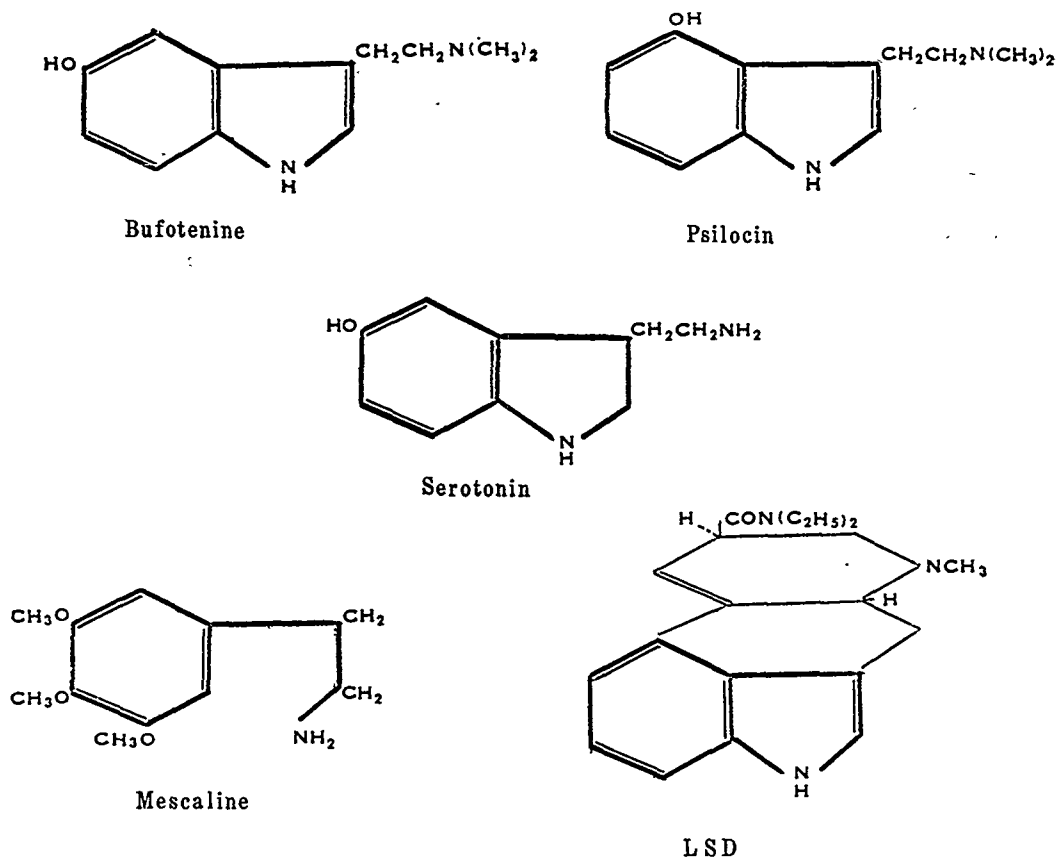


FIGURE 1

Serotonin, a putative chemical nerve transmitter, compared with hallucinogenic drugs. LSD, psilocin and bufotenine possess the same indole ring structure (in bold lines). Mescaline has structure resembling an indole ring.

derivative of LSD (2-brom LSD), although having the same serotonin antagonism action, was found to be devoid of psychotomimetic effects. Moreover, the levo-rotatory isomer of LSD is relatively inactive in comparison to the d-form with respect to serotonin inhibition and devoid of psychotomimetic actions. Only the d-LSD form of LSD compounds, therefore, is of interest here.

Also in corroboration to the similarity of the psychotomimetic activity of indoles is the observation that psilocybin and psilocin, the simplest chemical forms of tryptamines indoles yield effects similar to that of mescaline or LSD. The similarity of the effects of LSD and psilocybin or psilocin supported the idea that these two drugs possess perhaps some common metabolic mechanisms in causing psychic changes.

Psilocybin and psilocin found in psilocybe

mushrooms, which have been used by Mexican Indians in elaborate rituals for at least 3000 years, exert hallucinogenic effects. At high dosage, mystical or religious experiences are reported by subjects. That these experiences are different from what non-Indians report is probably due to a learning process. One visualizes what one is prepared to see or hear or experience.

The correlation of chemical structure and psychotomimetic activities of the indoles such as psilocybin and psilocin and LSD with those of the most important phenylethylamine, mescaline, found in the peyote plants are frequently cited in the literature.

Mescaline, a phenylalkylamine-type compound, is not a serotonin antagonist nor is it an indole-type compound that LSD and psilocybin and psilocin are. Yet it produces in man similar schizophrenic-

like reactions and also the strange effect of de-personalization³ with which LSD is characterized. On closer examination, the chemical structure of mescaline, 3, 4, 5-dimethoxyphenylethylamine, resembles closely those of indoles (see Figure 1). Hypothesis has arisen that mescaline is a precursor to indolic compounds in its eventual action in the body (13), however, the excretory products from mescaline use has not been shown to contain an indole compound (19).

The alteration of mescaline molecule to a 3-methoxy-4,5-methylene dioxy compound results in MDA, another psychotomimetic which bears resemblance to myristicin. The psychotomimetic effect of nutmeg was suggested by Shulgin (in 20) to be due to myristicin.

Amphetamine is an isopropylphenethylamine whose pharmacological action on the CNS is attributed in part to the free amine. It induces psychotropic effects if taken in large doses, and this response is attributed perhaps to the prevention of a putative nerve transmitter called norepinephrine from a re-uptake following its release from the nerve cells.

That norepinephrine, which is normally present in the brain, possesses a chemical structure similar to such psychotomimetic drugs as mescaline and amphetamines tempts speculations as to its role in abnormal metabolism in early schizophrenia. For these reasons, the psychotomimetics have been valuable in the study of the biochemical function of the nervous system.

The foregoing brief discussion of the action of psychotomimetic drugs has been presented so that a basis of comparison can be made with the effects from the inhalation of solvents used in industrial and household agents with those of LSD.

The "psychedelic" syndromes of LSD ingestion has been widely documented and reviewed in journals and exploited in popular literatures (14, 19, 22, 23, 24, 25, 26, 27). Since LSD syndrome is essentially the same as those for mescaline, psilocin, and psilocybin it is used as a point of reference in this discussion.

Table I lists some of the more important subjective effects of LSD in man. It is difficult to catalog subjective responses since these are idiosyncracies and are influenced by the individual set,

³ The subject feels that he has two forms, an intellectual and emotionless form which is able to observe the second form, a fantastic being of delusion and fantasy (13). Spectator and actor in the self, agent and agency appear fragmented and disintegrated.

by the setting in which the drugs are consumed, by his prior desires, his traits, his mood, and other accidental factors. The phantasy of his "psychedelic" experience may largely depend on suggested expectations (4).

MARIHUANA

The compilation of bibliography on marihuana, its chemistry, its ethnopharmacology, and its social and legal implications, is a major undertaking (28, 29, 30, 31), so voluminous have been the published papers.

Polemics and partisanship appear still to be dominant, and ideological issues contaminate an objective assessment. Some natural and social scientists claim that the "weed" is merely a mild intoxicant or euphoriant while others find it sufficiently psychoactive to be described as a psychotomimetic associated with some of the effects derived from LSD, mescaline, and psilocybin. The various effects are primarily dose-related. The fact that the active chemical constituents, THC (tetrahydrocannabinol isomers) are non-nitrogenous and structurally unrelated and that no cross-tolerance exists between 1-delta-9 tetrahydrocannabinol (from marihuana) and LSD in man (32), as the latter with mescaline, suggests that the mechanism of psychotomimetic actions produced by marihuana and LSD are not fundamentally the same. Like LSD, the hallucinogenic phenomena elicited by Cannabis must be directed, motivated or situation set, as demonstrated in controlled experiments by Weil et al (33).

The problem of characterizing marihuana's pharmacodynamics is in the determination of its active constituents. The tetrahydrocannabinols (THC) which were only recently synthesized have been tentatively assigned the principal active role, thus opening the door to controlled studies (34, 35). The delta-1 isomer of THC is considered the only important psychotomimetic agent in marihuana; the other active THC is called delta-6 THC contained in the marihuana in a quantity ten times less from that of the delta-1 isomer. THC is extracted from marihuana as an oily fat-soluble substance. Recent research activities suggest that THC exerts its action in the animal body as a more polar metabolite such as hydroxy THC (36). In man, 11-hydroxyl THC and possibly other polar metabolites of THC appeared to be present upon administration of THC (37). THC acts in the

Table I
EFFECTS OF LSD EXPERIENCE OBSERVED IN SOLVENT INHALATION*

LSD-type Symptoms	Glue Solvents	Paint Thinner	Gasoline
SOMATIC			
Dizziness & weakness	Present		Present
Nausea	Present, with vomiting	Present, with vomiting	Present, with vomiting
Drowsiness	Present	Present	Present
Paresthesia			Present, rare
Blurred vision	Double visions		Present
Anesthesia	Indicated		Indicated
	Amnesia		Amnesia
PERCEPTUAL			
Altered shape and color	Present	Altered shape only	Present
Sharpened sense of hearing			
Synesthesia (rare)			
PSYCHIC			
	Sense of lightness, of spinning, moving, floating, and magnetic pull	Same as in glue	Same as in glue
Distorted time & space	Space distortion	Space distortion	Space distortion
Difficulty in expressing thought	Present	Present	Present
Depersonalization	Not indicated	Not indicated	Not indicated
Dreamlike feeling	Present	Present	Present
Visual hallucination	Also auditory & tactile	Also auditory & tactile	Also auditory & tactile
Hyperacusis	Present	Present	Present
Euphoria	Present	Present	Present
	Micropsia	Micropsia	Micropsia
Ideational, delusional misinterpretation	Grandiosity	Grandiosity	Grandiosity
Altered mood, happy, sad & irritable	Loneliness	Loneliness	Loneliness

* From references 6, 7, 56, 61, 65, 71, 72, 73, 74, 75, 76, 77, 78, LSD syndrome according to 79.

manner of other fat soluble substances such as ether and alcohol but as a steric specific chemical.

Hollister et al (38) tested THC in man and observed clinical effects resembling those of psychotomimetics such as LSD, but differing in a longer euphoria, a more pronounced dreamlike sequence and a prominent sedation. For these reasons, THC action has been related to that of alcohol as well as to LSD. Unlike alcohol, however, marihuana does not induce hangovers even at high doses. The dosage level used ranged from 30 to 70 milligrams, with a median of 50 milligrams; LSD dosage, to obtain desired euphoric effects, is about 0.02 to 0.2 milligrams. These and other investigations have shown that THC induces effects of both alcohol and LSD, but until more information is

obtained it must be categorized on its own. No other drug agent, nevertheless, has a more intimate association with the "psychedelic" community as has marihuana.

Marihuana ultimately must be evaluated by its active constituents than by the subjective reports of behaviors elicited on smoking crude plant material. Smoking crushed marihuana plant material is analogous to smoking crushed opium poppy pods, both are chemically crude plant tissue materials containing less than 0.5% active chemical constituents. The concentrated extracts from opium poppy and marihuana on the other hand are what we know as opium and hashish.

On application of heat, the cannabinoids, including THC, volatilize and then condense on a

cool surface. In a simulated smoking experiment much of the THC has been shown to be trapped unchanged in the smoking machine (39). One of the present writers, working in a government testing laboratory, has detected large amounts of cannabinoids in the ashes of burnt cigarettes and in the stems of smoking pipes indicating that much of the active constituents of marihuana are trapped in the smoking paraphernalia, and it is presumed that only about a half of the active material finds its way into the body.

Ecological factors may also determine the strength of marihuana. Plants grown in a warm, humid climate seem to have a greater THC content than those grown in a temperature zone. Two genotypes of marihuana, however, have been suggested (40), one variety is of the "drug type" having a higher THC to Cannabidiol ratio than the "fiber type" having a lower ratio value of THC.

It should also be noted that much of the seized marihuana examined in laboratories contains stalk, twigs, and seed fragments all of which dilute and attenuate the psychotropic action of marihuana. Mold, mildew growth, and insect infestations are also common. The status of marihuana as a psychoactive agent must await a less ambiguous examination of the active principles derived from information that does not depend on studying the effect of smoking crushed plant materials. The availability of synthetic THC affords a chemically pure product for scientific study and makes possible an assessment of the full impact of the effect of marihuana in man.

NUTMEG

The active constituent of nutmeg remains a speculative matter. It has been commonly ascribed to myristicin which has been characterized as a monoamine oxidase enzyme inhibitor like tranylcypromine and iproniazid. Its action is presumed to increase the level of 5-hydroxytryptamine (serotonin) in the brain and thus perhaps to exert its narcotic property of inducing stupor (20).

Weil (41) describes reactions from nutmeg ingestion that range from no change to full-blown hallucinogenic experiences like those caused by hashish or LSD. Visual hallucination, distortion of time and space perception, and body image distortions have been reported. Feelings of depersonalization and unreality have been reported too. Payne (42) reported on 2 male college students who

ingested about 2 tablespoons of grated nutmeg and whose clinical symptoms involved exhilaration and intoxication followed by a persistent feeling of unreality for 48 to 60 hours. Payne noted that no hallucination appeared evident; "the effect is fairly well known among alcoholic patients and narcotic addicts whose regular supplies are exhausted."

Farnsworth (43) suggested that the psychotomimetic substance must be contained in the volatile oil of nutmeg, but he doubted, based on lack of responses in human experiments, that myristicin is the major psychoactive agent.

At the present time, most writers categorize nutmeg as "a psychedelic" rather than as an intoxicant (44) and have indicated that its action does differ appreciably from that of marihuana (45). Again, we are faced with the situation where the active principles must be isolated and fully characterized.

MORNING GLORY SEEDS

Its abuse was reported by Fink, et al (46) who noted the similarity to the effects induced by LSD. D-Lysergic acid monoethyl amide and d-isolysergic acid monoethylamide are the principal components of morning glory seeds and their comparative effects with LSD (d-lysergic acid diethylamide) have been delineated by Barron (26), Hofman (47) and others. Their psychotomimetic effects are somewhat less than those of LSD.

INHALANTS AND TOXIC PSYCHOSES

The search for euphoria and escape has led sniffing adolescents to sniff glue solvents, gasoline, lighter fluids, shoe polish, lacquer, deodorants, nail polish, laughing gas (nitrous oxide), etc.⁴

The social background of glue-sniffing is noted in an American Social Health Association leaflet by Winick and Goldstein (48) as well as in a study conducted in the New York slums by Preble and Laury (49). An extensive bibliography on glue-sniffing and other inhalants has been prepared by Kupperstein and Susman (50) who have also included newspaper reports. "Ether drinking" (51) has a historical reference for the "drug abuse" of the 1890's. Cherkins (52) looks back to 1799 when the poets Southey and Coleridge used laughing-

⁴There is a suggestion of the perverted ingestion known as pica to be considered here as drug users persist in a smorgasbord of compulsive promiscuous and indiscriminate pill-popping.

gas, and Sir Humphrey Davey documented a vivid description of his experience with laughing gas that appears to be similar to that elicited by complex molecules such as LSD and mescaline. It appears, therefore, that much of the acute effects of the inhalants are the consequence of a general CNS depressant.

Case reports (49, 53, 54, 55, 56, 57, 58, 59, 60) and studied works and reviews (6, 7, 61, 62) indicate transitory but apparent effects resembling the euphoric, hallucinatory, and other psychic effects of psychotomimetic drugs.

Although Von Oettingen (63) listed a few of these psychic responses obtained from a number of industrial chemicals, ranging from ethanol to extremely toxic carbon tetrachloride, the literature is devoid of the psychopharmacological discussion on industrial solvents. We must therefore rely on the subjective responses reported retrospectively in "glue-sniffing" and other deliberate inhalation of vapor from a limited number of common organic solvents. The factor of anticipation appears to play a dominant role in the individual's quest for the particular desired effect to obtain certain ecstasy or grandiose power through the use of these psychoactive agents.

The common agents of purposeful inhalation include aromatic hydrocarbons (e.g., toluene), hydrocarbons (e.g., hexane), halogenated hydrocarbons (e.g., chloroform), ketones (e.g., acetone), esters (e.g., ethyl acetate), glycols (e.g., ethylene glycol), and alcohol (e.g., ethyl alcohol). Ingredients used in some airplane model cements were listed by Barman, et al (64), Glaser (65), and in the bulletin on "Glue-Sniffing" issued by the National Clearinghouse for Poison Control Centers (66); some of the pathological effects of ingredients tricresyl phosphate, xylene, toluene, and acetone, were described. The active component of lighter fluid is generally naphtha, mixed with other aliphatic hydrocarbons. Ether, chloroform, and nitrous oxide in judicious amounts have been used as anesthetics, however, undesirable side effects have been present. The difficulty of evaluating commercially prepared solvents such as glue, gasoline, and lighter fluid lies in the fact that they are mixtures, and the subjective effects can not be attributed to one particular component.

Ethanol, or ethyl alcohol, may be one of the best inhalants for psychic purposes since it affords euphoria and mental well-being on prescribed dosage without the relatively rapid onset of toxic

and other undesirable side-effects. It is conceivable that other low molecular weight alcohol such as propanol and butanol used in model airplane cements would exert similar psychic effects on the CNS, the higher alcohols with lower vapor pressure would be relatively weaker. Toluene and benzene, common ingredients of glue and rubber cements products, are also shown to induce euphoria. Diplopia (double visions) was added to the list of effects since a number of writers have reported them in glue-sniffing. All in all, the present literature lacks psychopharmacological studies of individual solvents. A description of the toxic mechanism of aromatic hydrocarbons, such as toluene found commonly in glue, deserves some attention here.

Toluene is an example of a simple aromatic hydrocarbon which qualifies as a suitable inhalant since its odor is not disagreeable, and it has sufficient vapor pressure to effect a rapid onset of CNS depressant effect.

Contrary to LSD and morphine, the selectivity or specificity of action of the aromatic hydrocarbons at the CNS site is dependent on the number of molecules present at the particular moment rather than the type of molecule. Such physical effects as the vapor pressure of the solvents in the cells determine the quality of their action. Therefore, the depressant action of the alkylbenzenes (e.g., toluene, xylene) have much in common with those of alcohol, ketones, ether, and esters.

Benzene compounds with long alkyl chains, such as having 4 or 5 carbons in the chain, have little or no CNS depressant action because of low volatility. Toluene thus is a fast but short acting agent while such compounds as n-butylbenzene are slow and long acting. Those with a longer chain (e.g., phenyldodecane) are less volatile, like mineral oil, and have no narcotic potency.

The depressant action remains as long as the hydrocarbons are present in the nerve cells, but, as soon as these are removed, normal metabolic activity is restored. Chronic use of these solvents eventually leads to the degeneration of nerve cells, particularly in the brain, since these compounds are fat solvents. During the distribution of these solvents in the body, the red blood cells absorb them readily because of their high lipid content, and there is an accompanying destruction of blood building tissues and a depletion of oxygen supply. In chronic cases and in overdoses, the brain receives an inadequate supply of oxygen which

results in severe injury. It appears that narcosis and oxygen depletion go hand in hand. (Narcosis can occur also with adequate oxygenation.)

As in LSD and marihuana experiences, there are the suggestions of sexual stimulation associated with solvent inhalation. Ackerley and Gibson (67) reported autoerotic and homosexual activity in a 10-year old boy while under lighter fluid induced euphoria. Gwozdz (68) reported a bizarre case of the death of a 21-year old male who hanged himself with a plastic bag and cotton saturated with glue over his head during masturbation. One need not assume a pharmacological or physiologic base for aphrodisiac effects. These may be consequences of the lowering of inhibition, the "dissolution" of the superego, or other psychogenic factors.

Glaser (65) discussed a number of materials and techniques used in inducing what he called "inhalation psychosis". He noted that possibly "in some cases, at least, inhalation psychoses may be a deliriant similar to that induced by barbiturates and alcohol". If this is so, it is important to infer that the responses from inhalant experiences differ from the "psychoses induced by LSD and related compounds, which is not felt to be a delirium and which can be differentiated from deliria both objectively and subjectively".

Glaser remarks that in inhalation psychosis, the LSD and schizophrenic syndromes may occur only in individuals "whose psyche was in precarious balance prior to delirium". Those symptoms described by inhalers as auditory, visual, and tactile hallucinations and spatial distortions, macropsia, micropsia, and body image distortions may not develop in all cases.

Gleason et al (69) in *Clinical Toxicology of Commercial Products* discuss delirium attributed to drugs and chemicals and note that certain doses of LSD, mescaline, atropine, quinacrine, and especially the amphetamine group produce a heightening of perception and awareness rather than a reduction of awareness. However, they indicate that "in the late stages of severe poisoning with cerebral exhaustion, these toxic psychoses (from LSD type drugs) are not distinguishable from the delirium induced by the commoner sedative drugs".

Acute toxic psychosis is caused by a host of drugs and other noxae including heavy metal poisoning, hormones, oxygen depletion, water in toxic amount as well as glue solvents; they produce one or more of these disorders: mental clouding,

perceptual disturbances, and impaired motor activity. All seems to be characterized by clouding of consciousness and mental disorientation. We are mindful also of the effects of hypoxia in addition to the direct effect of solvent inhalation; Noguchi (70) noted that oxygen is usually excluded by methods sniffers use. Another possible effect is that from rising carbon monoxide induced from deep breathing, if there is re-breathing, it was stated.

LSD and mescaline appear to be exceptions and are distinguishable because they may model a psychotic state in that there is relatively lower impairment of cognitive functions, consciousness, memory, or comprehension. Remarkable is the highly specific and sensitive nature of LSD reaction since as little as 20 micrograms, or 0.02 gram, can initiate a train of hallucinatory, euphoric, illusionary reactions with a minimum of mind-clouding. The LSD effect is long-lived, lasting as long as 12 hours on a single dose.

In short, the toxic inhalants are rapidly absorbed into the bloodstream, the onset of psychic effect is rapid, and lasts as long as solvent effect occurs. Exhilaration, euphoria, and intoxication are the initial "desirable" effects, but these are rapidly displaced by headache, dizziness, impaired motor coordination, nausea, and vomiting. Sustained use may lead to coma and unconsciousness. Doubtlessly, there is a parallel between inhalants and alcohol drinking with one notable difference being the rapidity with which such solvents as benzene and toluene as well as with general anesthetics in contrast with alcohol reach the CNS. In general, most inhalants act similar to the anesthetics by causing disinhibition and general CNS depression.

Table I represents some of the subjective reactions observed in glue sniffing, paint thinners, and gasoline and are compared to those from LSD experiences. Since the effects of inhalation psychosis are gleaned mostly from case reports which in themselves are dependent on subjective recollections, some of the somatic and psychological responses may have not been accounted for. While there are general agreements, such somatic experiences as parasthesia probably went unreported in glue and thinner sniffing. For the subjective responses, the element of expectancy is of profound importance to the extent that it is said that if the subject is skeptical of the drug effects, he may suppress all sensory responses. The adolescents and those from economically impoverished families,

Table II
CHARACTERISTIC DIFFERENCES BETWEEN TOXIC INHALANTS AND PSYCHOTOMIMETIC DRUGS

Effects	Toxic Inhalants (glue solvents, gasoline, paint thinner, etc.)	Psychotomimetic Drugs (LSD, mescaline, psilocybin, etc.)
Odor or taste	Present	None
Action on tissue	Lipid solvent	No destructive action
Respiratory failure	Possible	Not indicated
Specificity of biochemical action	None	Highly
Narcosis & coma	Possible	Not indicated
Clouding of consciousness	Present, Impairment of cognitive function	Relatively none, high order of perception and alertness
Duration of action	Acute effect, shortlived	Long (6 to 12 hours)
Deliria	Present, confusion & disorientation	Not present
Behavior	Restless, stuporous, irrational, etc.	Passive—usually, but may exhibit panic reaction

seeking escape from reality may, on the other hand, lend themselves to hypersuggestibility of grandiose illusions. This may be why true hallucination is said to be of rare occurrence.

It is of interest to note that the inhalant symptoms do not include depersonalization, the out-of-the-body experience, which is invariably reported in LSD experiments. There appears to be no significant differences in symptoms derived from the inhalation of the three solvents.

Table II shows the distinctions between the effects of psychedelic drugs and of glue solvents, gasoline, and paint thinners. While the two groups share some of the psychic phenomena, the solvents do not exhibit the level of consciousness, the heightened perception, and the hyperalertness of the LSD experiences. Solvent inhalation leads to a state of mental deterioration. These features appear to differentiate the "psychedelic" drugs from the others.

While some LSD effects overlap those of other types of drugs such as the bromides, atropines, barbiturates, and cocaine, LSD appears not to induce other deleterious effects of toxic psychoses. The specific effect of the various chemicals on the brain is poorly understood, but the variety of psychological reactions obtained by drugs of different structural configurations indicate that there are probably specific locations in the brain even on a cellular or molecular basis which certain exogenous agents stimulate or depress. Evidently, LSD affects areas in which the level of consciousness is not diminished, i.e., the cognitive function is relatively unimpaired. Other compounds possessing

LSD-like effect may include DMT (dimethyltryptamine), DET (diethyltryptamine), bufotenine, psilocybin, psilocin, and possibly tetrahydrocannabinol (marihuana).

In contrast, the effect of organic solvents, including the alcohols, is that of intoxication at first but is followed by degenerative action on the nerve tissues leading to delirium, coma, etc. Gerade (80) has observed endothelial (fat linings) injuries in the kidney, liver, spleen, bladder, and thymus as well as in the brain and spinal cords due to aromatic hydrocarbon inhalation. Toxic overdose of the belladonnas, for example, induces symptoms of disorientation and deliria.

The term "psychedelia" is now used loosely and in a figurative sense as a label invoking the prestige of modern science. It has suggested factors that differ from those previously known to us as psychotoxic. But as we have noted, the physiological and behavioral responses subsumed under both the psychedelic and the psychotoxic labels overlap in part. The term "psychedelic" has no justified operational basis, and its use in the place of such words as psychoactive or psychotropic and hallucinogenic or psychotoxic belong more to the world of public relations than to that of science. Whether the state of "psychedelia" is purportedly achieved by solvent inhalation or by drug ingestion, it appears quite doubtful if there is a drug or any other agents which "enriches" the mind and "enlarges" vision. Succinctly stated by Freedman (81), "these (psychedelic) drugs do allow the mind to expand upon and vivify sensations; they shrink that part of the mind which exerts logical control".

SUMMARY

1. The meaning of various terms used to describe psychopharmacological drugs were compared with particular reference to the term "psychedelic", proposed by Humphry Osmond. Terms such as psychotropic, psychotoxic, psychotogenic, psychoactive, psychotomimetic, and hallucinogenic have been used interchangeably to describe the same group of drugs affecting the central nervous system. Psychedelic was introduced in preference to "psychotomimetic", a term which connotes drugs which mimic the ill-effects of psychosis. Psychotropic and psychoactive are neutral designations.

2. Some comparisons were made of the effects of glue solvent sniffing and LSD experience based on available literatures. Marked differences in actions were described; the former appear to cause generalized CNS depression. A transient period of intoxication is followed by deliria, coma, and, in some instances, death while the latter evokes a longer period of intensity, alertness, and keen sensory perception. The effects of LSD-type drugs, on the other hand, are induced by a comparatively small dosage; some of the psychic effects are also a result of side effects of toxic doses of other chemicals and drug compounds, ranging from bromides to gasoline to glue solvents. These experiences differ from those obtained from LSD in the loss of cognitive function because of their intoxicating action and/or delirium. In this critical confine, LSD and LSD-type drugs appear to be differentiated as psychedelics from other chemical agents which elicit similar subjective effects.

3. It is questionable whether the use of the term psychedelic in the differentiation of a unique configuration is now applicable. The connotation of psychedelic in the semantic sense is that of bizarre, harmless, and pleasure-giving sensations while the true experiences from drug-taking are fraught with psychotoxic reactions and dangers, both physical and psychic.

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