Inhalation Psychosis and Related States

A Review

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IT HAS LONG been known that affect and cognition may be considerably influenced by the inhalation of various substances. Both natural and artificial perfumes are prized for this very reason. Recently, however, attention has been drawn in both the professional and the popular press to persons who have become frankly psychotic while inhaling such substances as gasoline and model airplane glue. Because of the general concern in various quarters about these phenomena, a review of what has been learned appears to be indicated. It is quite possible that the further study and understanding of the states produced by the inhalation of such substances may reveal more differences than similarities, but in the present state of our knowledge it is more convenient to consider them together. In this discussion the pathological end point of these practices will be referred to as inhalation psychosis, and clinical syndromes due to inhalation but falling short of this end point will be referred to as related states.

The materials and techniques currently being used to induce inhalation psychosis and related states will be discussed, and both the acute and chronic states which may result will be considered. An attempt will be made to draw a composite picture of the person who inhales, and finally certain theoretical matters will be briefly explored. It must be emphasized that this report is not a statistical analysis of the studies in the literature. Because of variable reporting and difference of emphasis, such an analysis would not be highly meaningful.

Submitted for publication June 2, 1965.
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I. Materials and Techniques

By far the most popular substances used for the induction of inhalation psychosis are gasoline* and model airplane glue.† Both are mixtures. Gasoline is a mixture of petroleum hydrocarbons and contains paraffins, olefins, naphthenes, and aromatics; the aromatic hydrocarbons are chiefly benzene, toluene, and the xylenes. The proportions vary with the type of manufacturing process and the geographic origin of the crude petroleum.[45] Model airplane glues may contain a wide variety of substances including hexane, benzene, toluene, xylene, carbon tetrachloride, chloroform, ethylene dichloride, acetone, cyclohexanone, methyl ethyl ketone, methyl isobutyl ketone, amyl acetate, ethyl acetate, tricresyl phosphate, butyl alcohol, ethyl alcohol, and methyl cellosolve acetate.[27]

Paint thinner and lighter fluid have also been used.[3,4,11] Thinner generally contains butyl acetate, toluene, and ethyl alcohol, while lighter fluid is a mixture of aliphatic hydrocarbons, naphtha being the principal one. The use of toluene, chloroform, diethyl ether, and carbon monoxide in their pure state has been mentioned.[30,41,62,63] Such other materials as paint, nail polish remover, and laundry marking pencils have received brief notice. It is to the clinical states produced by most of the foregoing chemicals, singly and in their various combinations, that we shall turn our attention in what follows.

Similarities are at once noticable among these substances. With the exception of carbon monoxide they are all fat-soluble organic solvents. As such, they would be expected to pass the blood-brain barrier very rapidly. Their fat solubility also hints at myelin as a possible site of action, and one study of gasoline intoxication in a commercial setting mentioned both peripheral and central alterations of myelin.[45] However, the studies which have been done on industrial exposure to these solvents[32,40,45,73,76] do not approximate the conditions of acute, intermittent exposure to high levels of the vapors, and hence their applicability is open to question. The detailed pathologic physiology of inhalation psychosis and related states is clearly unknown at present.

* References 12, 15, 16, 19, 26, 31, 41, 50, 56, 57, and 69.
† References 7, 14, 27-29, 33, 34, 46, 47, 55, 65, 68, 71, and 72.

Inhalation techniques of a considerable variety have been reported. Most commonly, a handkerchief or rag is saturated with the material and then either held over the face or placed directly into the mouth. If the latter technique is perfected, it can be done surreptitiously and in such public places as school. Simple inhalation from a container of the substance is also employed. Model airplane glue is often evacuated into a paper or plastic bag which is then placed over the face or head to provide a high concentration of vapors. The dangers of this practice are quite considerable. Nine deaths from glue inhalation had been reported up to mid-1964, and of these six were definitely and one probably due to suffocation from the plastic bag.[72] In spite of this, merchants in some instances offered plastic bags for an additional penny with a purchase of model airplane glue, and refused to stop this practice when approached by health officials.[34]

Inhalers have proven resourceful in varying their technique. Some have found that heating most of these materials will result in higher vapor concentrations.[27] One child used a dispersion principle, distributing gasoline over the surface of a large salad bowl and then inhaling, somewhat after the technique of the brandy snifter.[57] Most enterprising of all have been certain Swedish school-children who placed paint thinner in perfume sprayers and sold sniffs to their habituated classmates.[11]

Reported schedules for inhalation vary considerably. Some users will inhale briefly but intensely, others for long periods which occasionally exceed 24 hours. In these cases inhalation is not usually constant but is returned to again and again over the 24-hour period. There is some suggestion that considerable individual variation exists as to which effects are considered to be desirable, and in the time required to produce them. Learning an adequate technique and becoming familiar with the effects of the inhalant are probably necessary before finding inhalation pleasurable, though some seem to find it so from the very first. In this, there are considerable parallels with the smoking of marijuana and the use of narcotics.[5,9,20]

II. The Nature of Inhalation Psychosis

Virtually all of what is known of the acute state produced by inhalation is derived from retrospective reports. Inhalation is generally not performed publicly, and the acute effects are short-lived. However, in one instance an attempt was made to simulate inhalation psychosis under experimental conditions, using paint thinner as the inhalant.

With the beginning of sniffing significant coughing appeared. A pleasant excitation was achieved after 15 to 25 "drags." After another 10 some odd drags, the maximum excitation was achieved. One of the experimental subjects fell afterwards into a deep sleep but of short duration. Pleasant drowsiness followed the sniffing. During continuous experimentation, neurological examination revealed a high degree of nystagmus, a positive Romberg, and a slurring of the speech. The experimental subjects were subjectively and objectively without signs and symptoms one hour after they had ceased sniffing.[11] ‡

These experimenters also took serial electroencephalographic tracings on one of their subjects; they are the only such acute state recordings reported. The authors describe "clear electroencephalographic changes" which they were able to correlate with alterations in the consciousness of their subject. The major finding was a decrease in frequency from 8-10/second waves to 4-6/second waves, and a decrease in regularity. These findings and the reproduced tracings are similar to what have been described as the stage 2 to stage 3 electroencephalographic changes of delirium.[59] §

Thus, it is possible that, in some cases at least, inhalation psychosis may be a delirium,[18,59] similar to that induced by barbiturates and alcohol. If this is so, it is important to note that it therefore differs from the psychosis induced by LSD-25 and related compounds, which is not felt to be a delirium and which can be differentiated from deliria both objectively and subjectively.[70,18,13] Statements to the contrary which have appeared may be due to the fact that they are based solely on retrospective date.[69]

Bleuler pointed out that the more evident clinical characteristics of a mental illness might consist of the reaction of the organism to the disease process, rather than the direct primary manifestations of the disease process itself.[6] He was concerned chiefly with the delusions and hallucinations of schizophrenia. The same phenomena—both visual and auditory hallucinations and paranoid delusions—are the most characteristically reported clinical manifestations of inhalation psychosis. As is the case in schizophrenia, they may be a reaction of the organism to the basic ego-weakening process, in this case a delirium. It is known that delusions and hallucinations may occur in deliria, and it has been suggested that they are more likely to occur in those whose psychic economy was in precarious balance prior to the delirium.[18] The same may be found to be true in inhalation psychosis. Other interesting clinical phenomena which have been

‡ Dr. Oliver Massengale supplied me with a translation of this article.

§ Since this manuscript was submitted a report containing EEG tracings in the acute phases of intoxication from glue sniffing has appeared. In my opinion it supports the interpretation of the EEG changes in inhalation psychosis as being indicative of delirium.[77]

reported in inhalation psychosis include tactile hallucinations, spatial distortions, macropsia and micropsia, and body image distortions. It must be emphasized again that not all persons who inhale develop this type of symptomatology.

Inhalation may become a chronic practice. Most writers believe that many more persons experiment with inhalation than become chronic users. But the degree of chronicity which may be achieved is considerable. In five reported cases, the duration of inhalation was in the neighborhood of ten years.[12,15,16,50,62] One is struck in many of the chronic cases by the strength of the need to inhale the preferred substance. Instances are reported independently from Ohio and Texas of parents literally chaining their children to prevent them from inhaling.[3,12] Both children broke free by dint of remarkable effort, and resumed inhalation; the boy in the latter case achieved newspaper notoriety as "The Sniffer."

Whether or not chronic inhalers can be said to be addicted is a question of some interest. If the strength of the urge to use is taken as the criterion, there can be little argument. Rado, for example, noted that "not the toxic agent, but the impulse to use it, makes an addict of a given individual, "and Fenichel added that "the word addiction hints at the urgency of the need and the final insufficiency of all attempts to satisfy it." [58,21] Chein and his co-workers felt that "craving" was a most important component of addiction.[10] If additional criteria of tolerance and physical dependence are added, however, the picture is less than clear. Such phenomena have been claimed to present in inhalation by a number of authors but have never been convincingly documented.

The question of organic damage to the CNS, liver, kidneys, bone marrow and other systems of the body due to chronic inhalation appears in like fashion not to have been definitively settled. Studies in which routine laboratory tests have been done have been equivocal in their results, and even more sophisticated techniques have produced no clear-cut answer. Neurological examinations have been infrequently reported but when given are negative, excepting only one instance of cerebellar disorder which was felt to be secondary to the inhalation of toluene.[30] Electroencephalograms of 19 cases in the chronic state are reported by 14 authors; in only five cases were abnormalities found.[15,19,41,62,69] None of the abnormalities was marked, and in one case there was a prior history of epilepsy. The applicability of industrial studies has already been noted to be questionable. Psychologists working with glue sniffers having a median number of 82 intoxications found no significant differences between them and a matched control group on psychological tests measuring a wide variety of cognitive functions, particularly those which they felt would be most vulnerable to organic brain disease.[14] Whether or not it is found that a certain amount of direct toxicity to various organ systems does exist, the practice of inhalation is dangerous and occasionally fatal, as in the cases where death was due to plastic bag suffocation. Further, the grandiose notions of invulnerability and of the power of flight which have been observed in some chronic cases [72] may have fatal outcomes, and the susceptibility of delirious individuals to such dangers as automobile accidents is also clear.

III. The Inhaler

We have considered the materials currently used for inhalation and the techniques employed, and surveyed the acute and chronic states associated with it. We may now consider certain characteristics of the inhaler himself, and attempt to draw a composite picture.

Age.—When first seen the inhaler is likely to be between the ages of 11 and 15, with the average age in most of the larger series being in the neighborhood of 13 years.[11,27,46,68] Since the average duration of inhalation practices is roughly one year, the average age of onset also falls within this range. In general this is a younger age than is reported for either juvenile alcoholics or juvenile drug addicts.[68,48] It may thus be an earlier indication of a difficult adolescence.

Of some interest are those who go beyond the limits of this age range in either direction. Nine cases began inhalation in their 10th year or earlier, and three of these [15,19,50] were 5 years old or less. This includes the case of a boy whose inhalation of gasoline began at the age of 18 months.[50] It was encouraged by the parents because it pacified the child; when seen by the reporting psychiatrists, he had achieved a duration of 10.5 years of inhalations. At the other end of the spectrum are three cases which were first

seen when the patients were more than 20 years of age;[30,62,63] in one case [63] the patient had begun inhaling at the age of 33. These cases comprise all of the reports of persons who have inhaled chemically pure substances, which would be expected to be more available to older persons. Such inhalants as model airplane glue are more available to youngsters. Studies of child alcoholics and of drug addicts in general, and particularly of physician addicts, have suggested that a factor of availability is of some importance in these conditions as well.[57,51,52,49]

Sex.—All reports state that inhalation is far more frequently a practice of males than of females. In 276 cases surveyed in which the sex of the inhaler is specified, there are but 22 females. A similar preponderance of males has been noted in both alcoholism and drug addiction.[68,42,36,48] Theories as to why this should be so either favor certain special psychological characteristics of females [2,10] or point to the greater strictures which society places on female activities in all spheres.[36] Neither answer by itself is perhaps wholly satisfactory, and the study of female inhalers may shed some new light on this problem.

Minority Group Status.—Three studies have reported a high percentage of cases among Spanish-American minority groups.[3, 27,65] On the other hand, there are reports of only eight Negro inhalers,[12,64] and in a Chicago study which found Negroes to be well represented among juvenile alcoholics and in the city population, there were no Negro inhalers. Such data are suggestive of historical trends among minority groups with respect to specific antisocial activities; for example, the percentage of Negro admissions for narcotics addiction to the USPHS Hospital at Lexington has fluctuated from 8.9% in 1936 to 52% in 1955 [53,44] to approximately 41% in 1964.‖

Concurrent Use of Other Addicting Substances.—Narcotic drugs are rarely ever reported as being used together with inhalants (although the sniffing of heroin and cocaine has long been known). With one exception,[68] however, most studies report that tobacco and alcohol are often employed by inhalers, sometimes to a rather unusual degree.[16,27,63] Along possibly related lines it is amusing to note an Australian boy of 11 years who was seen because of gasoline inhalation. "He said he had been eating rubber erasers at school for the last four years, had run out of them, had 'wanted something nice to do,' and so decided to sniff petrol, of which he had always liked the smell." [31]

Status of Home.—In ten individual cases in the literature, the home of the inhaler was physically broken by death, abandonment, or divorce. But since this datum is not given for many cases, it is difficult to arrive at an estimate of its significance. A comparative study showed no difference in the incidence of physically broken homes between glue-sniffers and juvenile alcoholics.[68]

Antisocial Activities.—Two groups contained within roughly the same temporal and spatial area, one of glue-sniffers and one of juvenile alcoholics, exhibited an identical rate of recidivism with respect to arrests, although the glue-sniffers were more likely to have been arrested previously for intoxication than were the alcoholics.[68] There were no differences between the groups as to type of crimes (conduct versus property offenses); as to the seriousness of the crimes, as judged by police juvenile specialists; or as to the incidence of group versus solitary offenses. Thus, in most respects, the two groups were indistinguishable in their antisocial activities.

There has been a continuing question as to whether glue, alcohol, and other agents have a direct effect in driving persons to commit antisocial acts, or whether their use is simply one characteristic of persons who also commit antisocial acts. The inhalation literature gives some support to both of these hypotheses.[47,69,3] It is important to note that most authorities hold that narcotic drugs do not produce crimes directly, since they have a marked quieting effect upon their users.[37,75] It is in connection with obtaining funds to purchase narcotics that crimes are committed by narcotics addicts, and these are generally crimes against property and not violent crimes against persons.

Intelligence.—In a well-controlled study no significant differences were found between glue-sniffers and normals.[46] Many of the inhalers do poorly in school, but this is not necessarily due to lack of intelligence. Moreover, it appears that inhalation practices of long duration are not incompatible with high academic attainment, including professorships at medical schools.[63] With respect to the 14 individual cases in which

‖ Personal communication, USPHS Hospital, Lexington, Ky, May 5, 1965.

intelligence quotients are reported, eight scored less than 100, and two of the eight less than 70. In those cases in which intellectual impairment existed it appeared to bear some relationship to the patient's general difficulties, but in the overall picture intelligence does not appear to be highly significant. This accords with studies in alcoholics and narcotics addicts.[54,38,48]

Diagnosis.—Only in nine surveyed cases had a diagnosis been made which was consistent with the standard nomenclature of the American Psychiatric Association. In five of these cases, the diagnosis was either schizoid personality or schizophrenia, but to draw valid conclusions from this small number of cases is difficult. Inspection of all cases surveyed appears to indicate that inhalation cuts across the whole spectrum of psychiatric diagnoses. If there is any preponderance, it is likely to be in the category of personality disturbances. There are parallel findings in alcoholism and narcotics addiction.[54,20,39,53] Felix's statement is perhaps apropos of all three groups: "The addict is not a creature apart from the psychiatric point of view. He differs from other psychiatric cases of the same class chiefly in his presenting symptom." [20]

Natural History.—What is the incidence and prevalence of inhalation? What percentage of experimenters go on to chronic use? Do inhalers eventually "graduate" into alcoholism and drug addiction? What is their fate, psychologically and socially? At present the answers to these and related questions are entirely unknown. There is only one report which includes a follow-up period of more than a year.[12] The careful application of epidemiologic techniques is urgently needed.

IV. The Etiology Inhalation Psychosis

At the present time, no single factor which is both necessary and sufficient to result in inhalation psychosis and related states may be identified, beyond those components which are necessary simply in terms of its definition, ie, an inhalant of some type and a means of inhaling it. The comparative data cited above indicate that etiologic factors operative in alcoholism and narcotics addiction might also be influential here. But this is not of great assistance, since there is considerable disagreement as to the causes of alcoholism and narcotics addiction. Disputes over whether social or psychological factors are more important would seem to be of little value in any of these problems. The literature clearly indicates that neither factor can be excluded with any justice in any case, though their relative degrees of importance may vary somewhat.

A rather intriguing problem with respect to etiology is the relationship between inhalation and smell. What role does the sense of smell play in leading to inhalation psychosis and related states? It would seem highly unlikely that no connection would exist. But one is struck by the paucity of reports by inhalers of the nature of the olfactory experience in inhalation. Nevertheless, if we accept it as part of the total phenomenon, we find an interesting situation in looking at the psychoanalytic literature concerning the sense of smell. Several authors have stressed the determining importance of oral factors in those who seek olfactory experiences.[22,24,74] Most of the writers of the classic period of psychoanalysis viewed such interests in the light of transmutations of coprophilia, an anal stage phenomenon.[25,1,23,29] The rather extraordinary relationship between smells and genital sexuality was noted by Havelock Ellis and earlier researchers whose work he summarizes.[17] It has been noted that

> Smell, as a special sense, is present from birth onward. As such it has an autonomy of its own. . . . It comes into association from the beginning with oral, anal, urethral and genital levels of psychosexual development. Smell experiences may be drawn into conflict at any or all of these levels, and as a result may serve to express the particular material of the conflict.[60]

Thus, even if smell were to prove to be intimately related to inhalation psychodynamically, it would provide no positive clues as to the involvement of a particular phase of development.

On a rather impressionistic level it may be noted that a general feeling of eroticism pervades many reports of inhalation. This has long been noted with respect to alcoholism and narcotics addiction as well, and its highly narcissistic quality has led some to view these phenomena in the light of autoerotic activity.[59,64] Masturbation is one of the earlier and more common situations in which the organism deals with impulses towards self-gratification. How it copes with this situation may be a paradigm of how it will cope with similar situations later in life. Spitz [66] noted a direct relationship between

the type of mothering received by an infant and the type of autoerotic play the infant engaged in. He found that "in the case of the infants where the relationship between mother and child was a problematic one, genital play was much rarer and other autoerotic activities tended to replace it. . . ." It remains to be seen whether addiction, inhalation, and alcoholism may be the later representatives of those "other autoerotic activities."

Finally, one cannot but be impressed with the wealth of fantasy material reported in cases of inhalation. The following intriguing report concerns the case of a 5-year-old child.

> Initially, he breathed the gasoline fumes only occasionally. Each time, however, he had a pleasant hallucination of friendly, pleasant, gnome-like men who were fond of him and spoke kindly to him. At this time parental discord was intense. The patient felt that his father was abusive and severe with him. "Father heckled me and gave my mother and me heck at everything we did." Because of this, he began to plot with the men of his hallucinations to remove his father. He said, "I want to make my father go away, so I can go off someplace with mom and we can make a living together and be happy on a farm." His hallucinations promised to help him if he would never call again. Quite by coincidence the father left on a three week's trip about this time. The patient interpreted this as the fulfillment of his wishes and believed the hallucinations helped him to do away with his father.[19]

The function of fantasy has been viewed as being "to create a wish-fulfilling situation which allows a certain amount of instinctual discharge—a discharge which would not be permitted in the existing circumstances of external reality—and which also corrects and modifies that reality in the imagination." [61] Since there is some evidence that inhalation facilitates such fantasies, one might speculate that it would appeal to those whose ability to fantasy is impaired. There is evidence that this is the case with narcotics addicts,[10] and it can be shown experimentally that narcotics increase the ability of an addict to fantasy.[8] It might also be the case that inhalation facilitates fantasies in those who are cut off from other avenues of instinctual discharge. For example, the circumstances of an isolated rural environment, a schizoid personality, limited intellectual endowment, or membership in a minority group might block certain of the commonly used paths to instinctual discharge and lead to a search for others, including discharge through fantasies facilitated by inhalation. All of these circumstances may be found among the cases of inhalation psychosis and related states.

V. Treatment

Because of its relatively brief duration it is unlikely that the acute form of inhalation psychosis will present itself for treatment. If it does, the general principles of the management of an acute delirium should probably be followed. This would include the elimination of ambiguous and misleading stimuli like shadows and whispered voices; the protection of the patient and others from his hostile outbursts; and the provision of a supportive and familiar environment in which continuous professional observation of the patient may be made. Because of the lack of evidence that a withdrawal syndrome exists, provision for gradual abstinence from the offending material does not appear to be necessary. The home or the hospital might serve as the locus for this treatment, though the latter would facilitate access to laboratory methods of assessment of organic damage to the bone marrow, liver, kidneys, and central nervous system. It would also lead more naturally to the thorough psychological and psychiatric examination which should follow. The case of the chronic inhaler has generally been managed on an outpatient basis, except when the patient's psychiatric condition necessitated hospitalization.

With respect to the overall problem preventive measures are clearly indicated and have been initiated along certain lines. Several laws have been passed in an effort to control inhalation practices, and conferences to share what has been learned have taken place.[72] The manufacturers of some of the products involved have experimented with the substitution of relatively nontoxic solvents and the addition of various irritants which would discourage inhalation. Public education programs may be expected to be helpful, if carried out in a judicious fashion; it has been cautioned that "while one is warning some youths, he may be instructing others." [68] It may also be reasonably expected that general social improvements may have an ameliorating effect on the incidence and prevalence of inhalation, as well as upon narcotics addiction and alcoholism. A very convincing demonstration has recently appeared which indicates that the potentially remediable condition of overcrowding may

affect the mother-child relationship and result in such illnesses in the child.[67]

Basic to all these approaches is the need for much more data concerning all of these problems. Rarely, if ever, may we be satisfied with the current state of our knowledge on any subject, and certainly not in the case of those under discussion here. Sir Thomas Browne, himself a physician, once wrote:

> The wisedome of God receives small honour from those vulgar heads that rudely stare about, and with a grosse rusticity admire his workers; those highly magnifie him, whose judicious enquiry into his acts, and deliberate research of his creatures, return the duty of a devout and learned admiration.
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> —*Religio Medici*

Summary

The practice of deliberate inhalation of a wide variety of substances containing organic solvents, especially gasoline and model airplane glue, has of late been widely reported. A number of techniques are employed in achieving an acute intoxication from these substances, which appears to be a toxic delirium. The impulse to engage in such practices may be very strong and may result in chronic usage, which resembles in some respects addiction to narcotics and to alcohol. Despite some dispute about the direct toxic effects of these substances on various organs, a number of deaths have been associated with the practice. Most cases reported are in their early teens, though the spread is considerable. The intoxicant used may bear some relationship to age-determined availability. There is a high preponderance of males, and broken homes and minority group status may also be seen. In some cases diminished intelligence is present. Unusual accessory utilization of tobacco and alcohol, but not of narcotics, is reported. The practice appears to be conducive to the performance of antisocial acts as well as being a favored outlet of those already antisocially inclined. The natural history of these practices is essentially unknown. A multifactorial approach to the etiology, treatment, and prevention of inhalation psychosis and related states seems most likely to prove valuable.

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