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September 25, 1969

SUBJECT: FACTS ABOUT LEAD AN
PEDIATRICS BULLETIN

To Members of Lead Industries Association, Inc.

Enclosed is our newly published bulletin "Facts About Lead and Pediatrics" and its companion pamphlet "Lead Poisoning in Children" a publication of the Children's Bureau, U.S. Department of Health, Education and Welfare, reprinted with their consent by LIA. Both booklets cover in detail the problem of childhood lead poisoning, its causes, symptoms and treatment.

The two booklets are being distributed by LIA to medical and public health officials, interested parties, legislators, and the press. We feel this to be a positive contribution from the lead industry for coping with the problem of lead poisoning in children.

More and more communities are becoming concerned with lead paint poisoning among children. If you know of any local action about this problem, you may find it useful for you personally to give copies of the "Bulletin" to local health or other officials. Also we would appreciate being informed of any developments relating to the lead paint problem.

Extra copies of the publications are available upon request.

Sincerely yours,

J. L. Kimberley p/o
J. L. Kimberley
Executive Vice President

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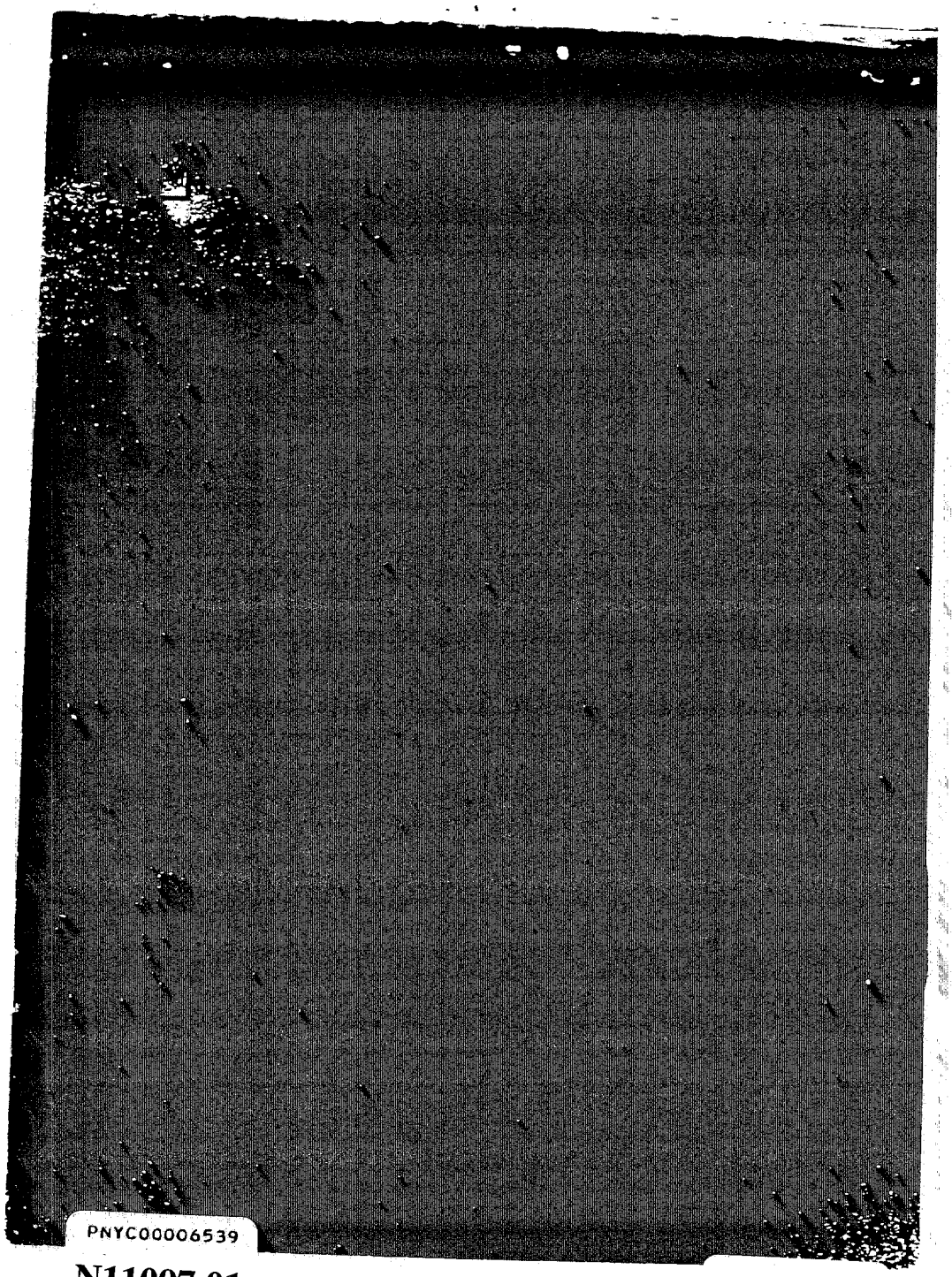

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Introduction

Great progress has been made in the past few decades to prevent and control the absorption of lead by both adults and children. Cases of lead intoxication, or plumbism, among adults are rare today, even in lead-processing and lead-using industries where the possibility of over-exposure seems greatest.

Such improvement is the result of broadly increasing knowledge about the physiological effects of lead, of the application of proper controls and safeguards to prevent over-exposure that can bring on illness and of better diagnosis and improved treatment of plumbism. Much of this increase in knowledge has come directly from scientific research encouraged or sponsored by the Lead Industries Association, Inc. (LIA) and its members.

One vexing problem area, however, remains a challenge. That is the absorption of lead by some children, particularly in city slum areas, as a result of eating leaded paint that was applied to the interior surfaces of buildings generally 50 years or more ago.

LIA's concern with lead poisoning problems is not new. The lead industry has for several decades supported research at leading universities and hospitals on the metabolism of lead and the diagnosis and treatment of lead poisoning in an effort to bring about better understanding of the problem. The information developed from such research has been disseminated in medical and public health journals and at various symposia. Basic research on lead intoxication was reported by Dr. Joseph C. Aub et al. of Harvard University in a monograph published in 1926. In 1933 the Kettering Laboratory of Applied Physiology at the University of Cincinnati, under the direction of Dr. Robert A. Kehoe, began publishing studies on lead absorption and excretion. LIA sponsored the early investigations of childhood lead poisoning by Dr. J. Julian Chisolm, Jr. et al. of Johns Hopkins University School of Medicine, as well as research on the treatment of lead absorption by chelation. Since 1937 a number of symposia on lead poisoning have been conducted by LIA, both alone and in cooperation with such organizations as the American Industrial Hygiene Association and the American Medical Association. These conferences have been held to make available to health professionals and interested laymen the facts concerning plumbism which underlie present-day concepts of its causation, prevention, and treatment. The lead industry today continues to support research in such areas as lead in the environment, the biological basis for lead intoxication, and the normal metabolism of lead, as part of its overall research program on all aspects of the use of lead.

Support for Legislation

For many years, representatives of LIA have met and consulted with public health officials concerning the problem of childhood lead intoxication. The industry has supported legislation designed to stop the use of leaded paints in interiors of residences and on furniture, toys and other items which children might chew.

Representatives of LIA have been members of the Sectional Committee on Prevention or Control of Hazards to children since it was organized in 1953 by the American Standards Association (now known as the USA Standards Institute) under the sponsorship of the American Academy of Pediatrics. This Committee developed a standard (Z66.1), in effect since 1955, which specifies that all paints for articles such as toys, furniture and the like, and for use in interiors of dwellings, should contain no harmful quantities of lead. (1)

Childhood lead intoxication, though relatively rare in the general population, still is a problem, particularly in the underprivileged areas of large cities. It is directly traceable to the fact that a number of children, many with pica (an unnatural craving for nonfood items), pick up and eat chips of paint flaking from walls or ceilings of old buildings erected when leaded paints were used in interiors (as they no longer are), or chew on lead-painted windowsills, baseboards or other surfaces.

Prevention Needs Cooperation

The knowledge and means are at hand for controlling this problem. But complete prevention calls for cooperative efforts among many groups, including parents, social and public health workers, doctors, landlords, city officials and public-spirited citizens.

Lead intoxication is a man-made disease, and as such is subject to complete control. To help achieve this objective, LIA has prepared this booklet especially for distribution to physicians, public health authorities, social workers, city officials and others who can help eventually achieve a solution.

Much has been done; much more remains to be done. LIA hopes this booklet, "Lead and Pediatrics," will contribute to the success of efforts aimed at preventing lead absorption by children. For additional information and recommendations, we suggest a careful reading of "Lead Poisoning in Children," by Dr. Jane S. Lin-Fu, a pamphlet (No. 452) published by the Children's Bureau of the U.S. Department of Health, Education and Welfare in 1967 (see copy enclosed). (2)

Contents

Plumbism is Preventable

The seven steps to prevention and control outlined in the box have been the basis of campaigns against childhood plumbism in a number of cities. Some of these experiences will be discussed in detail.

Physicians and public health authorities agree that lead intoxication in children is preventable. The source is known: old leaded paint in poor housing associated with poverty. There is no disputing that slum area dwellings painted many years ago with lead-bearing paint are the setting for virtually all cases of plumbism in children.

But many years of urban renewal and rehabilitation will be required before these sources of lead are eradicated. Lead problems can continue to occur in children whose parents neither keep their home free of lead paint sources nor seek medical attention until severe damage has been incurred.

Clean-up and constant alertness can prevent children getting at old paint and plaster chips. Parents can be urged into action. Peeling paint can be removed and chips cleaned up and removed from areas in which the child crawls or plays. Crumbling painted plaster and painted woodwork can be cleaned up, repaired and painted with modern interior-type paint. Parents and baby sitters must be alerted to the dangers of children chewing on lead painted surfaces.

Alertness to Symptoms

Diagnosis of lead intoxication [illegible] depend to a large degree on how [illegible] physicians look for it. They must be alert for vague and early symptoms in children and should investigate quickly and thoroughly the child's environment and history. They should not be lulled by the fact that modern interior paints are safe, the problem results mostly from underlying paint applied indoors years ago, frequently in once fine buildings that now are within economically depressed areas of many cities.

Seven Steps to Prevention

The problem of childhood plumbism is so clearly understood that it would seem prevention should be simple. It is not. This is because the problem is rooted in social, educational, economic, medical, technical and political factors.

Even so, a formula for prevention and control is offered, making it work will take time, patient effort, and perhaps new ideas and approaches. Some suggestions may be termed "impractical." Nonetheless, they pose a challenge to find a "practical" way of doing them.

The booklet will discuss in detail the components of this basic preventive formula which physicians, social workers, public health workers, parents and others should be aware of. The following steps are essential.

1. Alert and warn parents and others who live in dwellings which have leaded paint in interiors. As with other accidents involving children, parents (and other child caretakers)-can do much to keep children from eating paint and chewing painted surfaces and can keep chips off floors and out of reach of infants. (Almost all cases occur in children 5 years old or under.)

2. Remove sources of lead that children can eat. This source is almost invariably old leaded paint on interior walls, ceilings and trim. This leaded paint must be removed or effectively covered. One city (Baltimore) reports good results from covering walls to a height of four feet with wallboard. Lead paint on woodwork should be removed. Peeling paint and old plaster should be swept from floors and scraped from walls and ceilings.

3. Take steps to keep any child suspected of eating lead from further exposure. Remove the source of lead or keep the child from the source. "From three to six months of steady lead ingestion" precedes overt symptoms in almost all cases, according to the enclosed Children's Bureau pamphlet. (2)

4. Physicians, public health nurses and others should watch for early symptoms of lead absorption—[illegible] nonspecific symptoms of lethargy, irritability, and stomach pains and vomiting—and proceed at once to see that appropriate tests are made.

5. Quick and accurate diagnosis presents serious considerations. This should be done by the most modern methods to be sure whether lead ingestion has taken place, and should be based on clinical findings and supported by biochemical evidence of excessive lead absorption. Blood lead tests are considered the most reliable and accurate. Iron deficiency anemia is quite common in lead-poisoned children but not all children with this ailment turn out to have plumbism. Careful diagnosis of an ailing child's problem is essential. Lead frequently is not the cause and, if such proves true, a quite different treatment may be required.

6. Proper and careful treatment should start immediately after diagnosis of lead intoxication.

7. When a case is found, check other children in the home immediately for possible signs of lead absorption.

Some Campaign Histories

Experience shows that when well organized programs are pursued in a city the incidence of childhood plumbism can be reduced, usually after an initial rise in reported cases, and that fatalities and crippling illnesses can be greatly curtailed.

Baltimore: The long-term, intensive campaign in Baltimore is a prime example of what can be done through intelligent cooperation by all concerned. (3)

The hazard to children from old paint was first recognized by the Baltimore Health Department in 1931, and since 1935, the Health Department's Bureau of Laboratories has provided free blood lead determinations to physicians and hospitals. In 1949 a public health nurse was assigned to investigate reported instances of abnormal lead ingestion by children and to make sure that the old paint, or other source, was removed.

In 1951 the city adopted a regulation barring the use of heavily leaded paints in interiors of dwellings. A Baltimore ordinance requires a warning label on paint that contains more than 1 percent lead. The label must state that the paint contains lead, is harmful if eaten, and should not be used for interiors or for toys, cribs or other accessible, potentially hazardous surfaces.

Throughout the years the Baltimore Health Department has continued to maintain awareness of the problem through all available media. It has prepared pamphlets used by public health nurses and sanitarians in clinics and in home visits; in addition, information on lead hazards in paint has been mailed periodically to hospitals and physicians. Exhibits and other visual aids have been shown at meetings and in public buildings. Newspapers, radio and television stations, medical and public health publications, and other media have been used to inform the public of the hazards of ingestion of leaded paint by children.

Prevention Committee Organized

In order to pinpoint sources of lead paint, Baltimore's City Health Commissioner in 1957 organized a prevention committee of staff personnel directly concerned with the problem. The committee surveyed 100 blocks of dwellings and found more than 1 percent lead in paint in 70 percent of 867 dwelling units. Public health nurses collected paint scrapings from 300 homes of indigent persons and positive tests for lead were found in scrapings from 58 percent of the houses. Then action was taken to see that such paint was removed.

Five years later the committee began a pilot, "hard sell" educational program aimed at parents and others responsible for the care of children under 4 years of age living in selected areas where a high potential existed for lead intoxication from paint ingestion. The three-year program encompassed a person-to-person approach.

Painted surfaces accessible to children were inspected in the presence of the persons charged with their care. These people were instructed by the visiting sanitarian in the hazards of lead in paint and a leaflet was discussed and left for further study. When this leaflet was found to be above the educational level in the study area, a simpler version was prepared. In all, the sanitarian made five visits to each home to remind the parents of the hazards.

Morbidity-Mortality Data

The results may be seen in a 1968 pamphlet on the subject prepared by the Baltimore City Health Department which illustrates dramatically

*Official Baltimore Figures**

Child Lead Paint Poisoning 1931-1967

YEAR	CASES			DEATHS		
	TOTAL	WHITE	NONWHITE	TOTAL	WHITE	NONWHITE
TOTAL	1,111	203	908	136	46	90
1967	15	4	11	1	1	0
1966	32	2	30	1	0	1
1965	32	4	28	0	0	0
1964	45	3	42	1	0	1
1963	42	7	35	3	0	3
1962	44	3	41	1	0	1
1961	48	4	44	1	0	1
1960	53	9	44	4	1	3
1959	66	2	64	2	1	1
1958	133	17	116	10	3	7
1957	56	4	52	3	2	1
1956	48	8	40	3	1	2
1955	35	5	30	1	—	1
1954	34	8	26	3	1	2
1953	49	10	39	6	3	3
1952	29	6	23	5	2	3
1951	77	20	57	9	3	6
1950	31	2	29	2	—	2
1949	34	11	23	4	1	3
1948	31	4	27	4	1	3
1947	11	1	10	3	1	2
1946	13	7	6	4	2	2
1945	8	4	4	2	1	1
1944	9	5	4	1	—	1
1943	10	3	7	5	2	3
1942	13	1	12	5	—	5
1941	15	4	11	3	2	1
1940	12	3	9	7	—	7
1939	11	6	5	4	3	1
1938	13	9	4	6	4	2
1937	10	7	3	2	1	1
1936	19	12	7	8	4	4
1935	17	2	15	10	2	8
1934	10	4	6	6	2	4
1933	2	1	1	2	1	1
1932	2	1	1	2	1	1
1931	2	—	2	2	—	2

*"Lead Paint Poisoning in Children," pamphlet issued in 1968 by Baltimore City Health Department

the results of a well-organized, intensive program. (4) Reproduced on the opposite page is a table from this pamphlet summarizing child lead poisoning cases in Baltimore from 1931 through 196[illegible]

Briefly, the table shows that in 1931 two cases of lead poisoning in children were reported and both were fatal. No deaths occurred from childhood lead poisoning in 1965, which was the first year of record in which there were no deaths from this illness in Baltimore; furthermore, childhood lead poisoning cases totaled 32, the lowest since 1952.

The slight decline in case-findings from 1941 to 1945 reflects a wartime shortage of physicians. On the other hand, the sudden peak in 1958 resulted from the entry into the program of a large university hospital, plus the organization of the city prevention staff and the two lead-in-housing surveys of the previous year. Furthermore, it should be noted that the 10 deaths among 1958's 133 cases—or 7 percent of the total—were equalled only in 1935 when there were only 17 cases and the 10 deaths were over half of the total.

The experience recorded in the table shows that fatalities from lead can be reduced or prevented. It also demonstrates that in such a campaign, deaths decline as the number of cases rise, indicating improvement in speed and efficacy of treatment; and that thereafter, cases also tend to decline as prevention becomes more efficient.

Chicago: This city has been giving increasing attention to childhood plumbism in recent years. The City Board of Health has a preventive program under way and various citizens' groups also are actively involved in efforts to find and control the disease. The problem is a serious one in Chicago because of its large areas of old, rundown housing.

In the summer of 1965 residents of the East Garfield Park district organized a Citizens Committee to End Lead Poisoning (CCELP). This was done after the occurrence of several cases of lead intoxication in that area.

With the help of the American Friends Service Committee, CCELP began an educational and case-finding campaign. The City Board of Health, and later the Medical Committee for Human Rights, helped CCELP in testing urine samples obtained by high school students. Four plumbism cases were reported in the district from September through November.

The Board of Health undertook a widespread and continuing testing program; addresses of apartments where cases were found were turned over to the City Building Commission for corrective action.

From the start of the program in 1965 through September 1966, the Board of Health tested 30,000 urine samples. The city switched to a blood lead test in October. (In February 1963, the Board had begun a urinary coproporphyrin screening program in its clinics.)

As a result of the Board's expanded screening program, there was an increase in total cases being reported, from 24 in 1957 to 304 in 1966. At the same time, there was a significant drop in the fatality rate among reported cases, from 29.2 percent in 1957 to 1.6 percent in 1966. The Health Commissioner of Chicago, Dr. Morgan J. O'Connell, reported that the number of deaths among Chicago children from lead poisoning fell to 10 in 1968 from 14 in 1967. (5)

Mass Screening Program

In August 1966 the Chicago Board of Health began a mass screening program using a blood lead test. The children screened were from [illegible] Urban Progress Center areas. By April 1969 approximately [illegible] children had been tested.

During 1967 a total of [illegible] children had a blood test, and of these 5 percent (2,379) had lead [illegible] above 50 micrograms per [illegible] liters of blood. These children were referred to a special clinic established by the Board for the diagnosis and treatment of plumbism.

Of these children, 5[illegible]24 [illegible] of the suspects were [illegible] with chelates. Three percent [illegible] treated were 5 years of age, [illegible] were 4 years old, and the remaining 89 percent were 1-3 years old.

As a result of this program and educational impact in these [illegible] areas, the average blood lead level, the same population in [illegible] markedly lower.

According to Drs. Lorry A. Blanksma, Henrietta K. Sachs and Edward [illegible] Murray, all of the Chicago Board of Health, "Mass screening programs [illegible] blood lead determination can discover incipient intoxication weeks and probably months before the onset of [illegible] cephalopathy, thus reducing the [illegible] fatality rate." (6)

Recently the Chicago Board of Health made a film on the subject of lead poisoning in children. This film, titled "To Save a Life," provides a description of the steps taken, and the specialists involved, in combatting the problem and is being used especially in neighborhoods where lead poisoning may be a problem. (7)

Other Cities: Physicians in New York are encouraged to send blood specimens on all suspected cases to city health department laboratories where there are technicians specially trained to do blood lead level analyses quickly and accurately. As a result, the number of cases reported increased from 80 in 1954 to 725 in 1968. During the same period the fatalities among reported cases declined from 15 percent (12 deaths) to less than 1 percent (five deaths) in 1968.

New York's program on lead poisoning is being enlarged under the direction of a special task force within the city health department. The de-

partment holds sessions on the problem for physicians, social workers and nurses. Literature is distributed to the public, particularly to parents in "high risk" areas, by public health nurses and sanitarians. The city also uses people who live in the high risk areas to help identify possible cases of lead intoxicated children and to provide families with firsthand information about the dangers of eating lead paint.

Reported cases of childhood lead intoxication are followed up by a public health nurse to ensure treatment and necessary follow-up. Public health sanitarians inspect premises for sources of lead, effect necessary repair and repainting, sample and analyze peeling paint for lead content, and check other places where the child may regularly spend time. (8)

The Philadelphia Department of Public Health's program has been under way since 1956, with the cooperation of realtors, landlords, various industries (including a member company of LIAI and the Society of Friends. It includes systematic investigation of all reported cases. The Department issues a checklist of possible sources of lead for use in field investigations when the source of lead ingestion isn't readily apparent. It also issues specifications and safety standards for the removal of lead paint from interiors. The Department sponsored a two-day seminar on lead poisoning in June 1967 in which representatives of the lead industry participated.

Cause and Incidence of Childhood Plumbism

Although plumbism in children is a distinct and specific problem, its control must be viewed as one aspect of protecting infants and children from other home hazards.

The National Clearinghouse, Poison Control Branch, Division of Direct Health Services, of the U.S. Public Health Service, finds that 90 percent of all reported poisoning cases involve children under the age of 5 who have eaten or drunk substances found around the house. (9) In about half the cases, these substances are medicines of one kind or another. In the other half, household products such as cleaning and polishing agents, pesticides, turpentine, petroleum products and cosmetics are involved. In 1967, for example, among all substances "most frequently ingested" by such children, paint (leaded and nonleaded) ranks 26th, and involved 1 percent of the total reported from 395 centers in 43 states. However, many lead poisoning cases are not reported to these centers, so that such figures indicate the extent of acute poisoning cases from other substances but not from lead ingestion.

Studies have shown that almost every case of childhood plumbism is related to old lead paint in old buildings, a situation found mostly in large cities, mainly those east of the Mississippi River. In Baltimore, for example, where childhood plumbism has been brought under control, early studies showed that from 50 to 70 percent of old houses in some slum sections had flaking paint that contained lead.

Housing-Plumbism Relation

The relation of housing to plumbism was shown in a home survey of preschool children in Cleveland, which has had a study and control program for years. Of 801 children living in old houses, 216 (27 percent) had abnormal lead concentrations in their urine, and 38 (4.7 percent) were already afflicted with plumbism. Of 105 children in a new housing project, only three (2.85 percent) were found to have abnormal lead concentrations in their urine and there were no cases of plumbism. (10)

In some instances, a child may ingest lead from objects such as windowsills or repainted cribs when care has not been taken to avoid lead paints. Other possible sources are rarely reported and even more rarely established. Some epidemiological studies have indicated that symptomatic lead intoxication, particularly encephalopathy, is more common in the June-September period. However, lead intoxication may occur at any time of the year, and there is no season in which physicians and other public health workers should be less alert. (11)

Plumbism also shows close family relationships. If one member of a family is found to have plumbism, all the children between 1 and 5 years of age should be carefully checked, since there is a 33 percent incidence among children living in the same household.

Most victims are between 1 and 6 years of age, with 85 percent in the 1-3 year old group, as noted on page 5 of the Children's Bureau pamphlet. (2) These toddlers often crawl about without supervision. Either as an aspect of pica, or of the oral exploration usual to children of this age, they may pick up and eat paint chips found on the floors, or chew on cribs or windowsills that were long ago covered with lead-bearing paint. Certain lead compounds are known to have a somewhat sweet taste which may accentuate the appeal to children's palates. As pointed out on page 6 of the Children's Bureau booklet (2), "from three to six months of fairly steady lead ingestion" precedes the appearance of overt symptoms in almost all patients.

The Factor of Pica

Pica, a very common precondition, is the medical term for an unnatural craving for dirt or other nonfood items. Some studies found that from 70 to 90 percent of children suffering from plumbism had a history of pica. In a New York City study, more than 30 percent of children with a diagnosis of pica were found to have lead poisoning. (11) A study of 784 Baltimore

children from underprivileged areas disclosed that nearly 22 percent had pica. (12) In most cases, pica was established as a habit by the second year but had disappeared by the fourth or fifth year.

The causes of pica are unknown despite various theories. In the present state of knowledge, it should be recognized that pica is widespread, occurs particularly often in poor families, and is a potential source of metal and other poisoning, as well as of intestinal parasites.

Dr. Chisolm of Johns Hopkins, a long-time investigator in the field of childhood plumbism, notes that historically, pica "seems to be related mainly to the relative availability of a diet adequate both in quantity and quality to the social group as a whole. Women (especially pregnant women) and young children are the members of the group most vulnerable to pica." (13)

The Emotional Environment

Dr. Chisolm also points out that the symptom of pica is most likely to occur in children with a high level of mouth activity whose oral relief of anxiety "is reinforced by cultural patterns and to whom the mothering necessary to stop it is unavailable for a variety of reasons. When such a child is exposed to hazardous environmental lead sources, the likelihood of plumbism is indeed great." (13)

Medical Aspects of Childhood Plumbism

It is not the function of this booklet to give specific medical advice, but a brief review is given of the extensive literature on plumbism which the physician may consult in the usual manner.

The diagnosis and treatment of lead intoxication in children are complex and must be placed in the hands of experienced physicians. The enclosed pamphlet by the Children's Bureau offers 37 authoritative references. (2) In addition, a bibliography of references to some works in these fields by experts is printed at the end of this booklet.

However, everyone concerned with the problem should be aware of certain findings which should arouse suspicion at once. To physicians not actively engaged in pediatrics, symptoms and signs often are so commonplace and nonspecific that initially they may be overlooked. Cases may occur without being suspected; on the other hand, there are instances of illnesses erroneously diagnosed as lead poisoning.

It is important that all physicians, public health workers and others realize there is a childhood plumbism problem in urban slum areas. Being aware of this fact should make physicians more inclined to recognize and investigate symptoms they ordinarily would not associate with lead intoxication.

Check on Chewing and Pica

The presence of pica should especially arouse a physician's suspicions. Though most children pass through a stage of chewing on almost anything in reach, this habit should be gone by the age of 15 months and should never be of great intensity. Though the presence and history of pica is important, diagnosis should not rest on these alone. Many lead intoxicated patients have been found to have no history of pica when first examined.

A careful check should be made to determine the child's physical environment. A child with lead intoxication has almost always chewed lead painted materials, such as woodwork, plaster, wallpaper or putty, for at least three months before clinical signs appear. Though these materials themselves do not contain lead, they were often coated with leaded paint many years ago.

When a suspected case of childhood plumbism is seen, a check should be made to learn if the child lives in or frequently visits a house built before World War II. A list of "high-risk" addresses could be posted in all pediatric clinics to help physicians unfamiliar with the city. Most cities with the problem do have such areas of high risk.

Signs and Symptoms

A diagnosis of lead poisoning should be based on clinical findings and supported by biochemical evidence of excessive lead absorption, and, if possible, by evidence of unusual exposure.

There are a number of signs and symptoms which should arouse the suspicion of physicians and others, particularly if the patient lives in a slum area. They are not diagnostic by themselves, but are indications that emergency laboratory tests are required. The signs and symptoms listed below are not intended to be either definitive or exhaustive. For a thorough consideration of these sub-

jects, the physician should consult the medical literature.

The signs and symptoms of lead accumulation in children chiefly involve three organ systems: the gastrointestinal system, the central nervous system, and the hematologic system. (14)

The *gastrointestinal* symptoms are those which are most likely to be noticed first by parents and other laymen. They consist of vomiting, complaints of vague abdominal pain and constipation.

These are fairly common complaints among children, but the examining physician should be aware that plumbism may be the true underlying cause. He should also be aware that parents often are not of much help in his efforts to obtain definitive information. A survey of 300 children with confirmed cases of plumbism showed that 76 percent of them had no presenting complaints, but when specific and detailed inquiry was made, it was found that 58 percent had loss of appetite and 9 percent had vomiting. In another study of 22 children afflicted with severe lead encephalopathy, it was found that 18 had been treated symptomatically for "gastroenteritis" for different periods of time before symptoms of central nervous system involvement became apparent. Some of these children had also been treated for anemia, constipation, sugar in the urine, gait disturbance, and sudden onset of crossed or skewed eyes.

Central nervous system involvement: The most serious manifestations of childhood plumbism are those that result from involvement with the brain. These may range from drowsiness to deep unconsciousness (coma), or repeated fits (*grand mal* seizures). In some cases the first clues to the intoxication are repeated falling, clumsiness or loss of coordination. In other cases, convulsions may bring the child to medical attention. There also may be reading or behavior problems.

From the physician's point of view, there is nothing especially characteristic about the convulsions, for they may occur without fever and may be focal or generalized. However, if in the course of a few hours, the pattern of the seizures switches back and forth between right-sided, left-sided and generalized, the possibility of plumbism should be investigated. The physical examination in such cases may reveal inflammation of the optic nerve, ataxia (lack of muscular coordination), lethargy or seizures—with or without local paralysis and with or without reflex changes—and as such serves to confirm the involvement of the central nervous system but does not provide exact evidence of cause.

Hematological findings: Parents will be unable to detect changes in the blood of a possibly affected child. The physician may wish to check for anemia before asking for specific blood lead tests. Iron deficiency anemia is common in toddlers, and does not necessarily mean that the child has absorbed potentially toxic amounts of lead.

According to Dr. Chisolm, there are two groups of children involved: those with asymptomatic increased lead absorption, and those with lead poisoning. The first group, which probably contains the largest number, are children who show evidence of increased body lead burden without evidence of toxicity. The diagnosis of lead poisoning, Dr. Chisolm says, should be reserved for those children who, in addition to evidence of an increased body lead burden, also show biochemical evidence of toxicity. This latter evidence includes increased output of coproporphyrin and/or delta-aminolevulinic acid in urine.

"Some of these will show no clinical signs," Dr. Chisolm says. "Because of the nebulous nature of the clinical signs and symptoms, we should demand that patients with signs and symptoms suggestive of lead intoxication also have biochemical evidence of intoxication." (15)

Tests for Plumbism

As noted above, the presence of one or more hematological, intestinal or neurological signs or symptoms is not in itself diagnostic of pediatric lead intoxication. Laboratory tests are necessary for the physician to determine whether his patient has absorbed lead in quantities sufficient to induce illness.

By far the most reliable test for lead absorption is the quantitative determination of the lead content of the blood. Since speed is often extremely important in diagnosis of childhood plumbism so that proper treatment can be undertaken, such a test ought to be ordered immediately upon the first suspicion.

Blood lead concentrations should be interpreted with caution as these values can be affected by a number of factors such as competence and experience of laboratories and laboratory technicians, methods used in the collection and storing of samples, and possible recent administration of chelating agents.

Blood-lead concentrations of 40 to 60 micrograms per 100 milliliters of blood have been used by various agencies as the upper limit of the normal range for children. For example, the Chicago Board of Health refers all children with lead values above 50 micrograms to a special clinic for the diagnosis and treatment of lead poisoning, whereas other agencies have suggested 60 micrograms as the upper normal limit of blood lead concentrations. (11, 16, 17) There appears to be general agreement that blood-lead concentrations between 60-80 micrograms are indicative of abnormal absorption of lead, but often not of a degree of absorption which is capable of inducing symptoms of intoxication. Blood concentrations of 80 micrograms and above are considered to be potentially capable of inducing intoxication, requiring immediate action including both referral for treatment and removal of the child from the source of exposure.

Blood lead determinations are the most reliable method currently available to communities with active programs aimed at controlling childhood plumbism. According to Dr. Chisolm, a test recently developed for estimating delta-aminolevulinic acid (ALA) in urine is simple, rapid and inexpensive and may be suited for most screening if it can be shown that the concentration of ALA in random samples of urine provide sufficient discrimination between normal and lead-exposed children. However, further evaluation is necessary before it can be accepted. (Chicago Health Commissioner O'Connell says a 1967 study in that city, which is to be published, found ALA does not correlate with blood lead in screening for asymptomatic lead intoxication.)

Urine lead analyses are generally limited to usefulness in clinical research and in management of hospitalized cases because they require 24-hour collections of urine to yield useful data, says Dr. Chisolm. The edathamil calcium disodium (EDTA) mobilization test for lead also requires quantitative collection of urine and seems to be mostly useful in the study of older children suspected of having chronic plumbism, he notes. (13) (Dr. O'Connell says the EDTA mobilization test is used in all age groups in Chicago's lead clinic with urine collected for eight hours after intramuscular injection of EDTA. The test is very useful, he says.)

A recent major discussion of medical aspects is "Childhood Lead Poisoning – Comprehensive Management and Prevention," by Drs. J. Julian Chisolm and Eugene Kaplan, both of Johns Hopkins Medical School in Baltimore. Published in the December 1968 *Journal of Pediatrics* (Vol. 73, No. 6, pp. 942-950), this sums up the views and contributions of the authors and six other experts in the field who participated in a symposium held at Happy Hills Hospital in Baltimore on April 24, 1967. The symposium was held "to call attention to the need for a cooperative community approach to the social, environmental, and psychological aspects of the problem of children with lead intoxication."

Other major contributions include: "The Use of Chelating Agents in the Treatment of Acute and Chronic Lead Intoxication in Childhood," J. Julian Chisolm, Jr. in *Journal of Pediatrics* (Vol. 73, 1968); "Lead Poisoning in Childhood: Signs, Symptoms, Current Therapy, Clinical Expressions," Joseph Greengard, in *Clinical Pediatrics*, May 1966; and "Pediatric Lead Poisoning," Hugo Dunlop Smith, in *Archives of Environmental Health*, February 1964.

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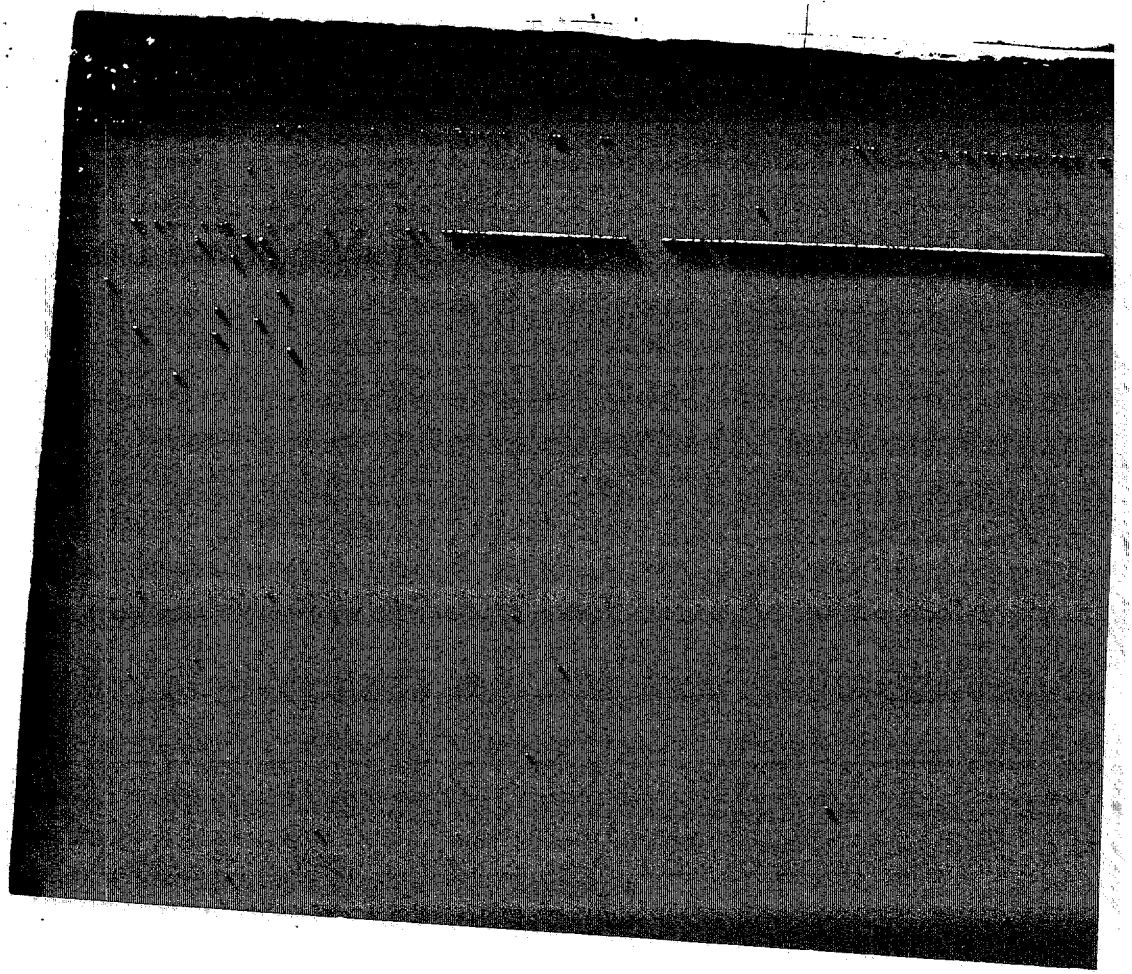

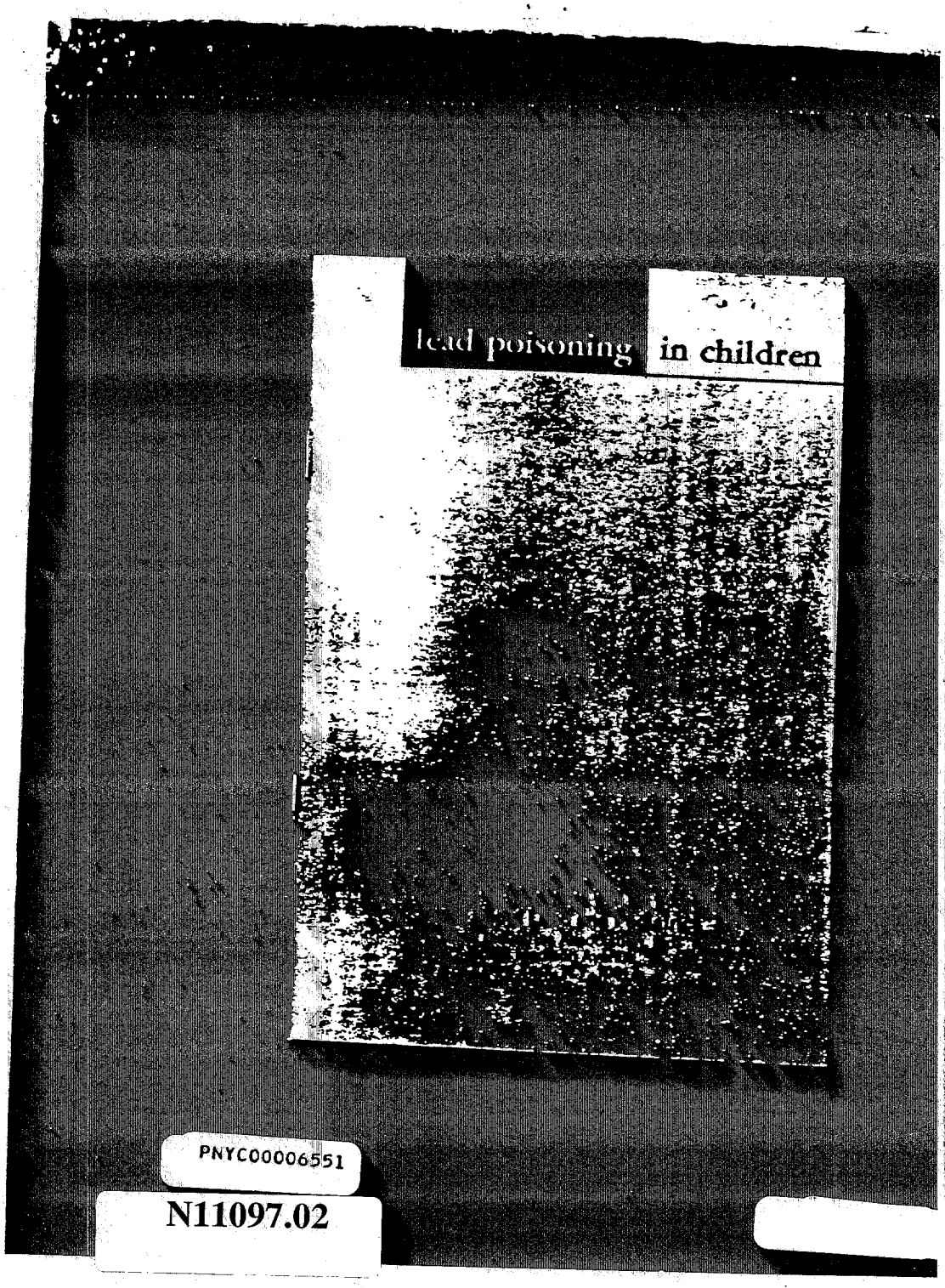

FOREWORD

Lead poisoning is a needless cause of mental retardation, other neurological handicaps and death among children.

LEAD POISONING IN CHILDREN [illegible] preventable nature of this health problem and to [illegible] stimulate some much needed action on [illegible] reduce the number and severity of lead poisoning cases among children:

- The public must be made aware [illegible] is preventable, be able to recognize its symptoms and seek appropriate medical help, and cooperate in efforts to eliminate this health problem.
- Physicians and other health workers need more information than many now have about the availability, diagnostic, screening and treatment methods, and cases are brought to their attention.
- Legislative action is needed to see that lead is removed from dilapidated housing and that adequate warnings are given in the use of any paint containing lead.

LEAD POISONING IN CHILDREN emphasizes that each of these steps is essential if progress is to be made in preventing needless death or handicapping to children living in our urban areas.

This publication deserves the attention of all health workers. It should serve as a useful guide to them and to others in planning an effective approach to the prevention of this health problem.

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lead poisoning in children

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lead poisoning in children

Lead poisoning in children, resulting mostly from ingestion of chips of lead containing paint from walls and woodwork in old, dilapidated housing, remains a unique public health problem. Its etiology, pathogenesis, pathophysiology, and epidemiology are known. Practical methods are available for screening, diagnosis, prevention, and treatment. Yet each year lead poisoning continues to cause the deaths of many children and mental retardation or other neurological handicaps in many other children.

Health workers should be reminded, and the public informed, that lead poisoning is preventable. As is true with many other diseases, total prevention may be difficult to achieve, but significant reduction in the number and severity of lead poisoning cases can be expected from a well planned program.

The following is an analysis of many facets of lead poisoning in children based on a review of the literature. A plan of approach to this health problem is suggested.

Size of the Problem

Lead poisoning in children is not an uncommon occurrence in the United States. Although slum areas in large old cities appear to have by far the greatest incidence, this problem is not necessarily restricted to the poor; it has been reported in children from economically and socially advantaged homes (*29*).

It is difficult if not impossible to assess the true incidence of lead poisoning in children. Obviously, in any community where overt lead poisoning associated with

pica is reported, many unrecognized, subclinical cases must also exist. But while one cannot talk in terms of incidence rates, from the number of cases reported in several large cities one must conclude that this health problem is quite common in many areas.

In New York City, over 500 confirmed cases of lead poisoning in children were reported in 1964. This is excluding over 100 suspected cases that were being observed or investigated. Of 61,167 poisonings reported to the New York City Poison Control Center between 1955 and 1963, 3 percent or 1,704 were cases of lead poisoning (*19*). In Baltimore, during 1956–1961, there were 1,337 known cases of lead poisoning in children (*12*). In Chicago, during 1959–1961, 429 cases of lead poisoning were reported to the board of health. They represented 4.7 percent of the cases of accidental poisoning reported in that period (*9*).

Since these reported cases merely represent a portion of the total extent of lead poisoning, perhaps the following survey data are a better indication of the actual prevalence of this problem in slum areas.

In Cleveland, a survey was conducted among 549 children aged 12–35 months living in areas of old, poorly maintained housing where flaking paint was frequently found. Of these children, 28 percent had an abnormal urine that might be indicative of increased exposure to lead, and 6.4 percent fulfilled the diagnostic criteria for lead poisoning. Of 105 children of similar socioeconomic background living in a new housing project, none had significant evidence of lead poisoning (*17*). In Baltimore, among 601 children aged 7–60 months who came from a low-income congested area where lead poisoning was known to have occurred, 333 had clinical or laboratory evidence or a history suggestive of increased exposure to lead. Of these 333, 148 had blood lead levels exceeding 0.05 mg./100 ml. (*4*). Survey of a suspected high incidence area in Chicago disclosed that out of 500 study patients,

7.9 percent had clinical or laboratory evidence compatible with the diagnosis of lead poisoning (*9*).

Consequences of Lead Poisoning

Mortality

In a 3-year period, 1959–1961, lead poisoning accounted for 4.7 percent of 9,853 cases of accidental poisoning in children reported to the Chicago Board of Health, but it was responsible for 70 percent of the total deaths due to accidental poisoning for the same period (*9*).

Between 1959 and 1963, 182 children were treated for acute lead encephalopathy at Cook County Children's Hospital. Over the 5-year period, despite the use of chelating agents and various techniques for reducing intracranial pressure, the case fatality rate remained essentially unchanged at the 25 percent level (except for one year when a higher fatality rate occurred, reportedly as a result of the bilateral craniectomies employed as part of the treatment that year) (*15*). In Cleveland, the mortality rate reported for lead poisoning from 1952 through 1958 was 30 percent (*17*). Coffin et al. recently reported a mortality of 4.5 percent in a group of 22 children with lead encephalopathy who were treated with a combination of BAL (British anti-lewisite) and CaEDTA (calcium disodium versenate) and measures to control cerebral edema (*10*).

Morbidity

For many of those who survive, the outlook remains grim. In Chicago, a study of 425 children who were fol-

lowed for 6 months to 10 years after treatment for lead poisoning revealed that 39 percent had some kind of neurological sequelae. Among the 59 children in this group who had presented encephalopathic symptoms initially, 82 percent were left with handicaps: 54 percent had recurrent seizures, 38 percent were mentally retarded, 13 percent had cerebral palsy, and 6 percent were found to have optic atrophy. Some had multiple handicaps (*30*). Other sequelae reported in children who had lead encephalopathy include behavior problems, inadequate interpersonal relationships and inability to comprehend the abstract (*5, 28*). Lead poisoning as a cause of chronic renal impairment is still a controversial subject (*17*), but there is strong evidence which indicates that late lead nephropathy is a sequela of protracted childhood lead poisoning (*8*).

The exact incidence of lead poisoning as a cause of mental retardation is not known, but limited surveys of blood lead levels among mentally retarded children suggest that the incidence is probably not infrequent (*3, 29, 37*). On the other hand, it has been contended that mentally retarded children are more likely to have pica and therefore more likely to have lead poisoning (*7*).

Several follow up studies have indicated impairment of intellectual ability in children who had lead poisoning. In the series of 425 children with lead poisoning reported from Chicago by Perlstein et al., mental retardation was found to be the most frequent sequela, occurring in 22 percent of the children. Among those who presented symptoms of lead encephalopathy initially, 38 percent of the children were found to be mentally retarded at the follow-up study, as mentioned above (*30*).

Similar results have been reported by other investigators. Byers and Lord followed 20 children who had relatively mild lead poisoning and were discharged from hospitals as recovered. They found that the IQ's of these children 3 to 12 years later ranged from 67–107, with a

mean of 90. All but one of these children showed unsatisfactory progress in school because of specific intellectual defect (*5, 6*). Jenkins and Mellins studied 32 children who had severe lead poisoning (nearly all had evidence of encephalopathy) and found that 6 to 8 months later, their IQ's ranged from 35–115, with a mean of 74. The majority were severely retarded (*21*). Smith reported that five or more years after lead poisoning, a group of children who had lead encephalopathy had an average IQ of 80 (range 58–104), while those who had lead poisoning without encephalopathy had an average IQ of 87 (range 75–117); a group of controls who had pica without lead poisoning had an average IQ of 98 (*33*).

Epidemiology of Lead Poisoning

1. "High risk" areas for lead poisoning are almost synonymous with the slums, where old, deteriorating housing prevails. In these areas, accessibility to flaking paint and broken plaster, high incidence of pica, and lack of adequate parental supervision provide an optimum environment for lead poisoning (*20*).

2. Children between the ages of 1 and 6 years are the main victims; those between 1 and 3 years of age comprise approximately 85 percent of the cases; with the highest incidence at age years (*20, 28*). Over 50 percent of all deaths from lead poisoning occur in 2-year-olds (*19*).

3. Childhood lead poisoning is significantly related to pica. In New York City it has been reported that over 30 percent of children who manifest pica have lead poisoning (*13*). Seventy to ninety percent of children with lead

poisoning have been found to have a history of pica (*4, 19, 22*).

4. Symptomatic lead poisoning in children has a definite seasonal variation. About 45 percent of the cases reported in New York City during 1954–1963 occurred in the summer months of June–September (*19, 22*). Others report that 80–85 percent of the cases occur in these months (*9*). But lead poisoning should not be considered a summertime disease. More and more cases are being reported in the winter months as health workers become increasingly aware of this problem. Some cases occur in winter when leaded battery casings are burned for fuel and the fumes are inhaled or there is prolonged contact with the ashes (*6, 35*). Epidemiologic studies indicate that lead encephalopathy is much more frequent during the summer, but asymptomatic lead poisoning is a year-round disease (*19*).

5. There is a high incidence among Negroes and Puerto Ricans, probably because a greater proportion of these groups live in the so-called lead belts (*20, 22*).

6. There is no significant difference in incidence by sex (*20*).

7. A high incidence occurs among siblings. McLaughlin reported 19 children with clinical lead poisoning from nine families; six of the children died (*27*). A 30 percent incidence among siblings has been cited by others (*14*).

8. There is a high recurrence rate (*27, 33, 35*).

9. Lead poisoning associated with pica is a chronic process. From 3 to 6 months of fairly steady lead ingestion is necessary in most cases before clinical manifestations develop (*11, 35*).

Diagnosis and Screening

Diagnosis

Since, in its early stage, lead poisoning is often asymptomatic or merely manifested by symptoms commonly seen in association with other diseases in everyday pediatric practice, to those unfamiliar with lead poisoning the correct diagnosis may not even be suspected. Vague, nonspecific symptoms, such as anorexia, abdominal pain, constipation, vomiting, anemia and irritability, are usual in early cases. Often, parents do not volunteer any pertinent information. A survey of 300 confirmed cases of lead poisoning revealed that 76 percent of the children had no presenting complaints, but on specific inquiry it was found that 58 percent of them had anorexia and 9 percent had vomiting (*19*). Among the 22 children with severe lead encephalopathy studied by Coffin et al. (*10*) 18 had been treated symptomatically by local physicians for "gastroenteritis" for varying periods prior to the onset of central nervous system symptoms. In addition, some had been treated for anemia, constipation, glycosuria, gait disturbances and sudden onset of strabismus.

A history of lead ingestion, or the presence of suggestive signs and symptoms in a young child is very useful in substantiating a diagnosis of lead poisoning, but confirmation of the diagnosis requires the demonstration of increased amounts of lead in blood or urine. Blood lead determination is widely accepted as the most reliable and practical method of diagnosing lead poisoning in children, as urinary lead determination requires a 24-hour specimen, and the excretion of lead is influenced by fluid intake, renal function and other factors (*19, 35*). Lead levels in blood should be interpreted with caution, since values are affected by factors such as hematocrit, intercurrent infection, coincident bone disease, or recent ad-

ministration of chelating agents (*8*). Caution should be taken to use lead free equipment in collecting and storing blood samples. Laboratories may vary in accuracy; a physician should be aware of any general tendency in the laboratory he uses to give high or low test results for blood lead determinations.

Jacobziner suggested the following criteria for making a diagnosis of lead poisoning: a blood lead level of 0.06 mg./100 ml. or higher, and the presence of two or more of the following signs and symptoms: gastrointestinal symptoms of anorexia, vomiting, abdominal pain, or constipation; hematologic finding of anemia or pallor; neurologic signs of irritability, stupor, lethargy, or convulsions; and roentgenologic signs of increased density of the long bones, or opacities representing lead flakes in the abdomen. If a patient is asymptomatic but has a definite history of pica and a blood lead level of 0.06 mg./100 ml., he is classified as a "possible" case of lead poisoning, and periodic blood lead determinations are carried out (*19*).

Recently, Chisolm proposed that the "normal" blood lead level be revised downward. According to him, after infancy the median blood lead level is 0.027 mg./100 ml., and the upper normal limit should be set at 0.04 mg./100 ml. The widely used limits for normal of 0.05 and 0.06 mg./100 ml. were based on the use of samples containing a large proportion of young children from old urban housing areas who may have had increased exposure to lead (*8*).

The so called classical signs of lead poisoning, i.e., lead lines on bone X rays, radiopaque materials in the gastrointestinal tract, basophilic stippling of erythrocytes, and coproporphyrinuria, are often absent, especially in early cases and in children under 2 years. In one study, only 17 percent of patients with early lead poisoning and 45 percent of those with late poisoning had positive or borderline lead lines on X rays. In four of eight children with lead encephalopathy, the X rays were normal (*31*).

Basophilic stippling was reported to be present in 60 percent of childhood cases of lead poisoning by one author, and in only 30 40 percent of cases by another (*16*). Similarly, coproporphyrin III is sometimes absent in the urine of children with lead poisoning (*4, 10*). In one survey, blood lead determination was positive (0.06 mg./100 ml. or higher) in 37 percent of the suspected cases, but urinary coproporphyrinuria of 2+ or higher was present in only 5.5 percent of the patients (*19*). These "typical" signs are therefore only useful if present, and their absence does not rule out the possibility of lead intoxication. It is obvious that if one were to wait for the classical signs to appear before making a diagnosis, many children would have progressed to the stage of irreversible neurological damage while others would be diagnosed only on autopsy tables.

Many workers in this field feel strongly that treatment should be begun on any child with clinical symptoms suggestive of lead poisoning or any child with abnormally high blood lead levels even if he is symptom-free. Treatment should not be delayed until a conclusive diagnosis is available (*8*).

Large-scale screening methods

While blood lead determination is the accepted method of diagnosis, it is not suited for large-scale screening in old slum areas because of its cost and complexity.

Urinary coproporphyrin determination has been used by some health workers, but its value as a screening test has been questioned by others (*11, 13*). While the usual technique is relatively simple, positive results may be indicative of conditions other than lead intoxication, and negative results are frequently encountered in the presence of lead poisoning. Benson and Chisolm have devised a urinary coproporphyrin test which they have found to be uni-

formly positive (3 + or 4 +) in patients with whole blood lead concentration greater than 0.10 mg. per 100 gm. (*2*). The test is less useful for detecting children with lower elevations of blood lead level.

Urinary excretion of delta aminolevulinic acid (ALA) is increased in lead poisoning, and Cramer and Selander were able to demonstrate a close correlation between this substance and blood lead level (*12*). But the rather complicated and time consuming technique of urinary ALA determination as described by Mauzerall and Granick precludes its use as a screening device for lead poisoning on a large scale (*26*). Recently Davis et al. reported a modified method using disposable ion-exchange chromatographic columns which permits rapid determination of this substance. The pilot study conducted by Davis et al. in Chicago indicated that the relative simplicity of this technique, the rapidity with which the determination can be done, the requirement of only 1 ml. of urine for the test, and the reasonably low cost involved are the outstanding advantages of this method (*13*). However, the validity of this method as a screening device for lead poisoning in children remains to be confirmed, since the incidence of false positives and negatives is not known. Aside from lead poisoning, porphyria is also known to be associated with increased urinary ALA.

Hair, a continuously growing tissue which provides a metabolically passive and irreversible pathway for lead, is known to concentrate more lead per unit weight than any other tissue or body fluid, including bone, blood, and urine. Recently Kopito, Byers, and Shwachman studied the lead content of hair of 16 children with confirmed diagnosis of chronic lead poisoning (*24*). With one exception all had either elevated concentration of lead in their hair or significantly higher values in the segments proximal to the scalp in comparison with the distal segments. The

mean lead concentration in hair of the 16 children with lead poisoning was 282 μg./gm., while that of 41 control children with 24 μg./gm., a difference of high statistical significance. In eight children, the concentration of lead in the proximal segment was 1.5–3.8 times higher than in the distal segment. The procedure requires only 10 mg. of hair in 5 to 10 mm. segments. The ready availability of hair as a specimen, the ease with which it can be collected, sorted and transported, and the reasonably simple technique of this procedure are the salient features which favor it as a screening device for lead poisoning in children. Further corroboration is essential, however, before this procedure can be accepted as a reliable screening test.

Two other tests reported to be valuable for screening of this condition are the determination of fluorescence of erythrocytes (fluorescytes) (*36*) and ophthalmoscopic examination for retinal stippling (*34*). These tests also require further evaluation.

Factors Contributing to Lead Poisoning

Although lead can be absorbed into the body via various routes such as inhalation and skin absorption, in children lead poisoning results almost exclusively from ingestion of flaking and peeling lead-containing paints found in old houses and on old furniture. Some of the most important factors which work together to perpetuate lead poisoning in children include:

Dilapidated housing

In the large, old cities, there is a marked concentration of lead poisoning cases in slum areas—the so-called

lead belts. Here, dwellings often have several coats of paint on walls, woodwork, and ceilings, and the base coats generally contain significant amounts of lead. Until about 1940, lead containing paint was frequently used in interiors as well as exteriors of houses. The houses are usually in bad repair and paint peelings and loosened plaster provide a dangerous source of lead to children with pica. Thus, despite legislative effort to prohibit the use of lead-containing paint for interiors, lead poisoning continues to occur in children living in slums.

A 1958 survey of 100 dwellings occupied by Puerto Ricans in Philadelphia revealed that 87 percent had at least one room in which the lead content of the painted surface was above 1 percent, the maximum level considered safe (*18*). In 1957, a survey of 100 blocks of dwellings in Baltimore randomly selected for lead paint sampling disclosed that 70 percent of 667 dwelling units had paint containing lead in excess of 1 percent (*32*). In contrast, lead poisoning was not found among children living in newly constructed housing projects in New York City, even in the so-called high incidence districts. This indicates that lead poisoning in children is inextricably linked to old, dilapidated housing (*19*).

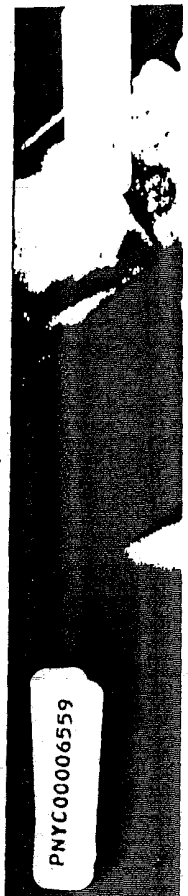
Lack of awareness about the problem among physicians and other health workers

Many physicians are not aware of the existence or the magnitude of this problem of lead poisoning, either because they seldom encounter cases of it in their practice or because the cases, when encountered, are not correctly diagnosed. In New York City, where several hundred confirmed cases of lead poisoning are reported annually, not a single case was reported to have been seen at a large medical center over a 3 year period (*1*).

Some equate the manufacture of lead-free paint today with the extinction of lead poisoning in children. What they do not realize is that old houses often still contain many layers of lead-containing paints, that today paints manufactured for outdoor use still contain lead, and that people unaware of the hazard of lead may use the outdoor paint for interior purposes.

An illustration of the misconceptions some physicians have concerning lead poisoning in children is the case of an 18-month-old boy who was admitted to the Massachusetts General Hospital with lead encephalopathy. The child was known to have pica, and, a few months prior to admission, he was seen by two physicians on separate occasions. One physician did not consider the possibility of lead poisoning because he had the common misconception that paint ingestion is harmless since interior paints manufactured today do not contain lead. The other erroneously informed the mother that drinking large amounts of milk will prevent lead poisoning due to paint ingestion (*14*).

Even among those who are aware of the problem of lead poisoning, some are hesitant to make a positive diagnosis. A large number of cases have been reported by hospitals to the Poison Control Center of New York City as "possible lead poisoning" despite highly suggestive clinical symptoms and blood lead levels considerably above the standard used for positive diagnosis (0.06 mg./100 ml.). One child admitted to a hospital with convulsions and vomiting had a blood lead level of 0.32 mg./100 ml. Although this was more than five times the level accepted for diagnosis, the child was reported as a case of "possible lead poisoning" (*21*). Hesitancy in making a diagnosis often leads to undue delay in treatment, and the loss of invaluable time during which irreparable damage may occur.



A poorly informed public

Many parents are not aware of the danger associated with pica or the consequence of paint ingestion. Jacobziner reported that, in 90 percent of the cases of lead poisoning in New York City, the family knew that the child was ingesting paint but were unaware that this practice was hazardous (*19*). Another example of lead poisoning directly related to the lack of public information about the sources of lead intoxication is the sporadic occurrence of large scale poisoning from inhalation of lead fumes produced by burning wooden battery casings impregnated with lead salts for fuel (*8, 35*). Lead poisoning associated with ingestion of home grown vegetables produced on a soil containing numerous lead battery casings has also been reported (*29*).

Inadequate prevention of reexposure to lead

There is a high rate of recurrence of lead poisoning among children. In a series reported by Smith, 19 percent of 229 cases of lead poisoning in Cincinnati had recurrent episodes (*35*). McLaughlin of New York City reported a total of 151 admissions of 143 children over a 5-year period. Several children were admitted two and three times, each time with recurrent encephalopathy. In one case, repeated episodes left the child completely incapacitated (*27*). Others working in the field of lead poisoning have also stated that "we saw the same children over and over again being brought in for more deleading, and each time with evidence of more encephalopathy, more residual brain damage. We were seeing mental retardates and institutional vegetables created right under our eyes" (*11*).

It is thus apparent that failure to prevent reexposure to lead contributes significantly to the mortality and morbidity of lead poisoning. Chisolm and Harrison have emphasized that the severity of residual handicaps may be correlated with the duration of exposure to lead and with the incidence of recurrent episodes (*7*).

An Approach to Control and Prevention

Knowledge of the epidemiologic data and factors contributing to lead poisoning in children can be translated into programs directed at the control and prevention of this health hazard. The effectiveness of such programs is best illustrated by the results obtained in New York City. After programs were set up for early diagnosis and treatment, the number of children with lead poisoning reported annually rose from an average of 29 during 1950–1954 to over 500 in 1964. Simultaneously, the fatality rate dropped from 27 percent (1950–1954) to 1.4 percent in 1964 (*19*).

In the following plan of approach to control and prevention, action is suggested in several areas: professional and public education; casefinding; followup of cases; legislative measures; research; and improved housing.

Educational campaign

Directed to physicians and other health workers. The encouraging results in New York City were attributed to the early casefinding techniques, and increasing the phy-

sician's awareness of lead poisoning was a major factor in early casefinding, according to Jacobziner (*20*). Educational programs for the medical profession, nurses and other health workers in the form of talks, exhibits, and distribution of literature can be conducted in medical and nursing schools, hospital conferences, and professional meetings and conventions. Physicians must be made aware that lead poisoning is still a health problem today. They must learn to make routine inquiry about pica in children 1-6 years of age. They must also learn to think of lead poisoning when confronted with children who have symptoms compatible with that diagnosis. They must become familiar with the methods of screening and diagnosis, and know what facilities and services are available locally for making a diagnosis (such as blood lead level determination by the health department).

Directed to the public. The public and, in particular, parents with young children, should be informed of the hazards of lead, the sources of lead (old paints, plaster, storage battery casings, gasoline, etc.), the methods by which lead poisoning can occur (ingestion, inhalation, etc.), and the danger in pica. They should learn to recognize the early symptoms of lead poisoning, and be instructed to seek medical help when such poisoning is suspected.

Casefinding program

Screening in clinics, hospitals, and health projects (e.g., Children and Youth Projects supported by the Children's Bureau, the Head Start projects):

1. Routine inquiry about pica in all children 6 years old or younger.

2. Blood lead level determination in all children with a history of pica, and in siblings of children with either positive lead poisoning or pica.

3. Reevaluation at regular intervals of children with pica who at initial screening did not have toxic blood lead levels. Children in "high risk" areas who have pica are in constant danger of lead poisoning, and an initial negative screening test does not guarantee that they may not be poisoned later on.

4. Screening of children from "high risk" areas by other methods, such as urinary ALA determination, should be considered.

Home surveys. Home visits are especially useful when parents of children with lead poisoning fail to bring siblings in for screening. Similarly, visits to families living in a housing project where lead poisoning has occurred will often uncover other cases.

Provision of prompt service in blood lead determination by local health departments. The health department of New York City reports results of blood lead determination to physicians and hospitals within 24 hours after receipt of the specimen (*20*). In other places, it may take much longer (*11*). In many cases, delay in diagnosis leads to delay in treatment, which in turn increases the risk of encephalopathy and irreversible damage in the patient.

Followup program

Prevention of reexposure to lead. Since lead poisoning usually occurs among those least able to improve their environment, prevention of reexposure will in many cases require formidable efforts by health and social workers:

4. Instruction of the parents when a child is discharged from the hospital or clinic after treatment, regarding the seriousness of repeated exposure to lead.

2. Home visits by health workers to determine whether exposure to lead is continuing and to help the family prevent further exposure.

3. Removal of lead from environment. Paint removal is an expensive, time consuming process, but it should nevertheless be required of the landlord when it is necessary for prevention of reexposure. The child should not be allowed in the home while lead paint is being removed, since there would be great danger of further exposure.

4. In some cities and hospitals, whenever removal of lead from a home is not immediately feasible, the child is placed in a convalescent or foster home until his home has been made safe or the parents have found better housing. This measure may not be practicable in many places because of the lack of suitable foster homes, but it should certainly be considered whenever the only alternative is to send a child home to a dangerous situation.

5. Additional social casework, if indicated, to reduce psychological or cultural factors resulting in pica in the child.

Determination of blood lead levels at regular intervals. This should be done in cases where prevention of reexposure to lead has failed.

Legislation

In those jurisdictions, particularly those including large urban areas, where the following measures are not in effect, legislative action ought to be considered:

1. Reporting by physicians of lead poisoning cases to local health departments.

2. Ordinances requiring that dwelling places be maintained in good repair and fit for human habitation, and that any condition found to be dangerous or detrimental to life or health (such as flaking lead-containing paint and loose plaster coated with such paint) be removed.

3. Prohibition of the use of paints containing lead for indoor purposes and on toys and furniture.

4. Warning labels on all paints containing more than 1 percent lead.

Further research

Causes and treatment of pica. Pica is a serious problem among children. In the Children's Hospital of the District of Columbia it was reported to occur in 50-60 percent of all children 1-2 years old in the Negro clinic population. Among the white private patients, the incidence was still surprisingly high—28 percent of the 1- to 2-year olds (*11*). Pica is responsible not only for lead poisoning, but also for other types of accidental poisoning in children. In the Children's Hospital of the District of Columbia it was found that in children admitted because of ingestion of poisons, 67 percent of those in the early age group had pica (*11*).

Various psychological and cultural factors have been cited as contributing to the development of pica. Improper child-rearing practices in particular have been said to result in needs in the child which he satisfies through pica (*26*). Further research into the causes and treatment

of pica is a logical step in combating accidental poisoning in childhood.

Laboratory screening procedure for lead poisoning. Determination of urinary ALA (delta aminolevulinic acid) and determination of lead concentrations in hair hold promise of being practical and reliable means of detecting children in the early stages of lead poisoning. The respective technique of Davis et al. and Kopito et al. seem to have important practical features, as described above. Well designed investigations are now necessary to evaluate the reliability and sensitivity of these methods.

Treatment of lead encephalopathy. The report of Coffin et al. indicates that improved methods of treatment can effect a marked reduction in the mortality associated with lead encephalopathy. But in the series of cases reported the residual morbidity caused by lead encephalopathy remained high. Seven of the twenty-two children treated were left with residual injuries. Although the use of both BAL and CaEDTA removed lead from the body and brain cells more effectively than when either agent was used alone, the control of cerebral edema remained a difficult problem. Various therapeutic agents, including urea, mannitol, and dexamethasone, and surgical decompression have been used to combat this problem, but none has proved to be completely satisfactory. Continued research to reduce both the mortality and morbidity from lead encephalopathy is urgently needed.

Slum clearance

Among the benefits of clearing cities of old, dilapidated housing is the reduction of lead poisoning in children due to paint ingestion. This point should not be overlooked in the proposals of citizens and government leaders for slum clearance and for improved low-cost housing. Because these goals in housing are far from being achieved in most large cities, however, they cannot be relied upon as the main routes by which lead poisoning will be prevented in today's young children. Educational campaigns, casefinding, followup, and other programs must be carried on vigorously as specific measures against lead poisoning in children.

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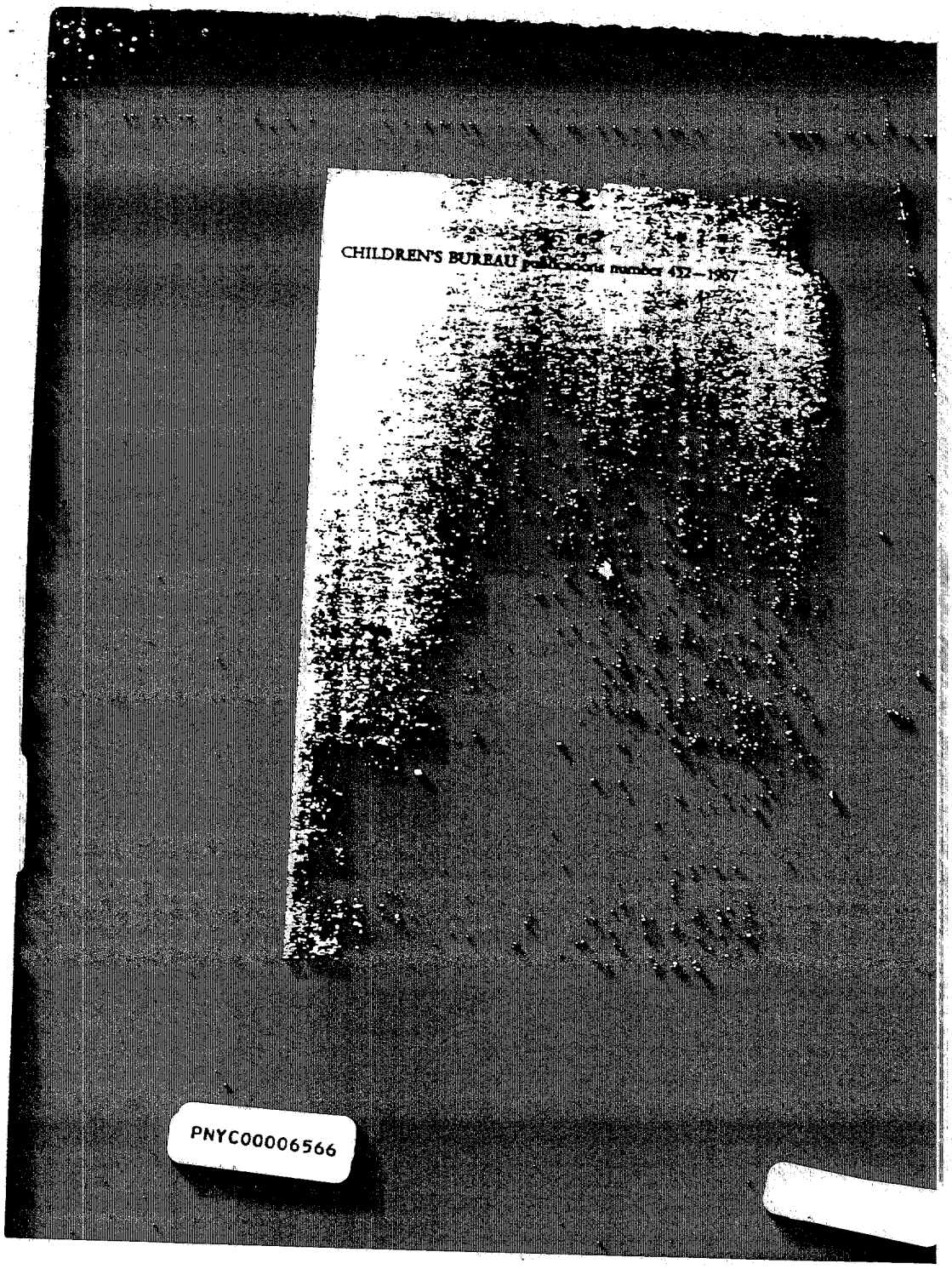
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