HEALTH HAZARDS AT LOVE CANAL

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Introduction

My name is Beverly Paigen. I am a cancer research scientist at Roswell Park Memorial Institute in Buffalo, New York. Roswell Park is part of the New York State Department of Health. I have a Ph.D. in biology and my research interest is genetic susceptibility to environmental toxins. I served on the Environmental Protection Agency's Toxic Substances Advisory Committee from 1977-1979. I currently serve on an Environmental Protection Agency group (the Carcinogen Assessment Group) that makes quantitative risk assessments of hazards from cancer-causing chemicals.

Summary of Health Effects

The studies that I will present concern the health hazards experienced by the people still living from one to five blocks from the Love Canal dump site. I will present information that leads me to conclude that toxic chemicals are presently migrating through the soil along the paths of old streambeds that once criss-crossed the neighborhood. Families whose homes border these old streambeds show an increase in several health problems including miscarriages, birth defects, nervous breakdowns, asthma and diseases of the urinary system. These studies have led me to conclude that a minimum of 140 additional families should be evacuated immediately and evacuation may need to be extended to as many as 500 more families. In addition, the results raise questions about whether the presently planned remedial construction to prevent further outflow of toxic wastes is adequate.

Methodology

Originally, the State of New York investigated miscarriages and birth defects in the residents living in rings 1 and 2 immediately surrounding the Love Canal and concluded that both were increased. On the basis of this they declared a health emergency and evacuated 239 families from rings 1 and 2. The residents left behind living in the area from one to five blocks from Love Canal also felt that birth defects and other diseases were higher than should be expected in their neighborhood. These residents began collecting information in an informal way on diseases in the neighborhood and plotting these on a map. The diseases seemed to cluster in particular areas of the neighborhood.

older residents suggested that the clusters seemed to follow the path of old streambeds that had intersected the Love Canal many years ago and had been filled when houses were built. At this point the residents contacted me for help since I am known locally as an environmental scientist. I discussed with area residents how to collect health information in a scientifically acceptable way. They put aside all the information they had gathered and started making a systematic phone survey to each home, collecting information about the number of persons in each family, the length of time they had lived in the Love Canal area, and the health problems experienced by the family. More than 75% of the homes cooperated in the survey. This information provided the data base I used. I should point out that this survey suffers from several problems. First, a layperson reported diseases to a layperson and some of the people involved may not understand the true nature of their illnesses. Second, both the people reporting and the people collecting the information have a vested interest in the outcome and there may be over-reporting of disease. And third, I did not have any resources so I could not verify independently the reports of disease with physician records. To overcome these problems I concentrated primarily on those health effects that are diagnosed by a physician and that the layperson knows by name. To correct for over-reporting I used internal controls in the neighborhood. I will present the health effects in 3 categories of confidence: the first are those diseases for which there is clear and convincing evidence of an increase; the second category are those diseases that are probably elevated but which have some problems with the data; and the third category includes health problems for which there is suggestive evidence, but which I was not able to evaluate for lack of sufficient information.

The Swales

The first step was to locate the old stream beds. This was done by examining old aerial photographs and geological survey maps, obtaining photographs from residents' family albums, and talking to older residents. In addition, the State of New York sent interviewers from home to home to determine which houses had been built in historically wet or swampy areas. During this process we discovered that in addition to the streams, there had been a lake and several swamps in the neighborhood. I have here, for instance, a photograph of the Love Canal area (Figure 1) taken in the early 1950's at the time that Hooker Chemical was still dumping toxic waste. The canal is partially filled. Here is the path of a stream bed that intersected Love Canal. Area residents tell us that this could flow in either direction. When the Niagara River flooded in early spring it flowed to the north. At other times of the year it flowed to the south. Here is an old family photo from 1958 which shows two children playing in the stream bed (Figure 2). It appears to be about 10 feet deep and more than 20 feet wide. The soil in this area is clay and is relatively impermeable to the flow of liquids. When the area was developed, the streams were filled with building rubble through which water flows easily. The result is that today, even though there is no surface evidence of these old streams, liquid contaminated with toxic chemicals is migrating along them underground. The next photograph has on it in red the stream beds that were

Original in Poor Condition
Image not Digitized

Original in Poor Condition
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Original in Poor Condition
Image not Digitized

present in a 1938 aerial photograph (Figure 3). In yellow are the stream beds present in a later aerial photograph indicating that some relocation of streams occurred during the construction period. The yellow dots in this photograph indicate each home that lies along a stream bed or in a historically wet place, that is where a lake or a swamp was. In the health studies which I will be showing you, I have compared the disease incidence in these homes on historically wet areas with the disease incidence in homes in dry areas. The collection of health data to the west of the canal are still not complete.

The data I will show you are limited to this area (indicate on photograph). The first map (Figure 4) shows the homes in the study area; each home that cooperated in the study is covered by a dot. More than 75% of the homes participated in the survey and the homes which did not are randomly scattered through the neighborhood. At some points the study area was divided for statistical purposes into north and south along this line (indicated on map).

It is important to keep in mind that the health effects I will be presenting are probably serious underestimates of the true health effects. One reason is that I don't have a normal control population. I am comparing a heavily exposed population - those in wet homes - to a moderately exposed population - those in dry homes - and I don't have any unexposed population. A second reason is that my data usually do not include the evacuated families who were the most heavily exposed. A third reason is that people with no health problems readily cooperated in the survey, but some families with serious health problems did not wish to participate in a survey conducted by their neighbors.

Toxicity to the Very Young

One of the most susceptible groups in the general population to the toxic effects of chemicals are the very young. In the Love Canal area, miscarriages, still births, and crib deaths are increased. This table (Table 1) indicates total pregnancies and miscarriages verified by physicians in these women before they moved to the Love Canal and after moving to wet areas in Love Canal. The frequency of miscarriages before moving to Love Canal was 8 1/2% and this increased to 25% for women when living in Love Canal homes in wet areas. This is a risk 3 time greater for women living in the wet areas.

This map (Figure 5) indicates each miscarriage, still birth, or crib death with a blue dot. I have omitted the houses and streets to protect the identity of the individuals who gave confidential medical information, but I have indicated the stream beds and have outlined the swampy areas. Each dot is about the width of a house lot. The stream beds are indicated by a line even though they have considerable width. Miscarriages are more frequent in homes lying in wet areas than in the homes in dry areas.

FIGURE 4. Study Area. Each home that participated in survey is covered with a circle.

Table 1

MISCARRIAGES IN WOMEN LIVING IN LOVE CANAL AREA

	Number of pregnancies	Number of miscarriages	%
Before moving to Love Canal	714	61	8.5%
After moving to wet area of Love Canal	155	39	25.2%
Relative risk	3.0		

chi square 35; probability that difference is due to chance is much less than .0005

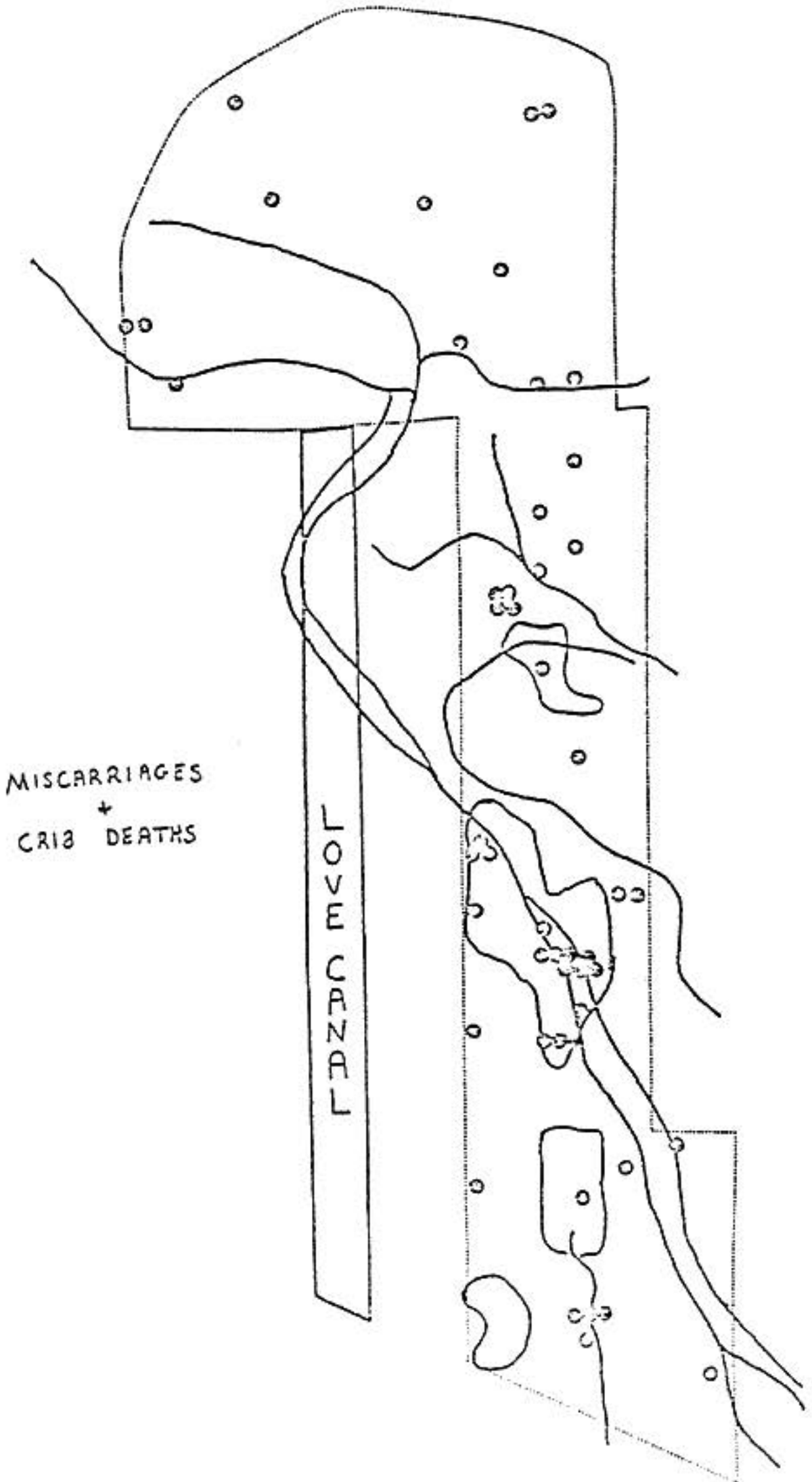

FIGURE 5.

A number of women have had multiple miscarriages; these women ive in or very near the wet places. This woman, for instance, had normal pregnancies resulting in healthy children before moving to the Love Canal. When she moved to Love Canal she had 4 miscarriages in a row; the last miscarriage occurred at 6 months and the child was deformed so the distraught woman decided not to have any more children. This woman had 3 miscarriages; one of the children she managed to have was born with 3 ears, and another has deformed ears.

Within the last month, the Environmental Protection Agency halted the use of herbicide containing dioxin (TCDD) after 8 Oregon women wrote that they had 13 miscarriages among them. Two hundred tons of this banned herbicide are buried in Love Canal and the toxic contaminant dioxin has been found in the leachate migrating from the canal.

The presence of birth defects is another sign of chemical toxicity in the very young. In this map (Figure 6) each blue dot represents a child born with a birth defect. Again clustering occurs with more birth defects in those homes in wet areas as compared to homes in dry areas. This table (Table 2) indicates the percentage of birth defects in the official study by the New York State Department of Health. All these have been verified by physician records. Twelve percent of children born in the wet areas had birth defects compared to 5% of children born in dry homes. My own survey includes more birth defects than the official study by the State of New York. My information indicates that 20% of children born in the wet areas have birth defects compared to about 7% of children in the dry areas. I am currently corresponding with the State over the differences, and I believe the true incidence will lie somewhere between the incidence I have and the incidence that the Health Department has. I do not know whether the rate of birth defects for children in dry areas is higher or comparable to that expected for a normal control population.

Some of the birth defects in this survey were minor or easily corrected by surgery, such as webbed toes, an extra toe or extra or unusually spaced teeth. Others, however, were much more serious including a deaf child, 5 children with mental retardation, 6 with kidney abnormalities, and 3 with heart defects.

Most people believe that the flow of chemicals into the neighborhood has gotten worse in the recent past - perhaps because the drums containing the taxic wastes are rusting through and perhaps because we have had 2 winters of abnormally heavy precipitation. We therefore asked whether there has been a particularly noticeable increase in birth defects among the children born in the last 5 years to women living in wet areas. From 1974-1978, 16 children were born in homes in wet areas; 9 of these children had birth defects (Table 3). This gives an incidence of over 50%, clearly an unacceptable health hazard.

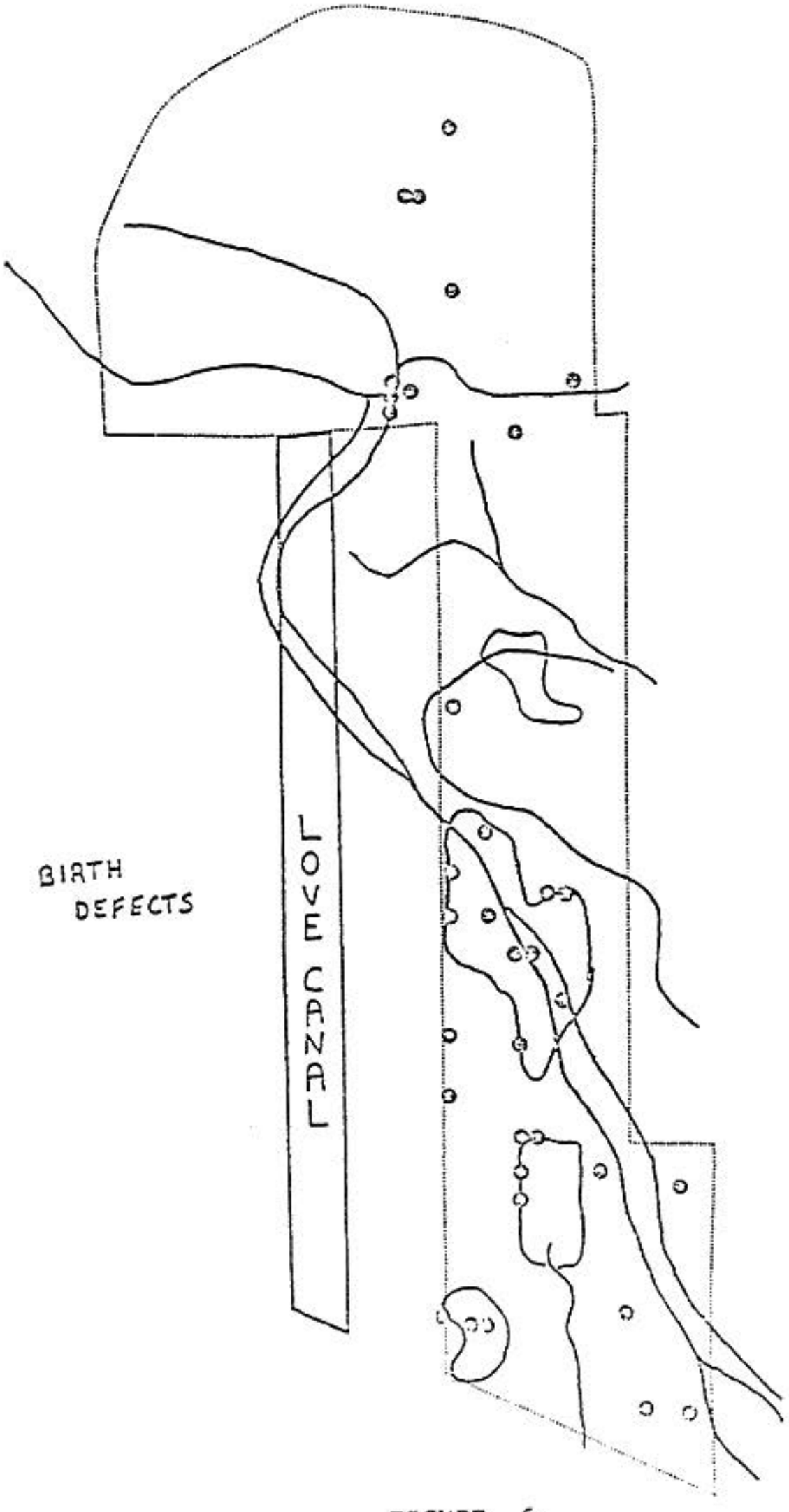

FIGURE 6.

Table 2

BIRTH DEFECTS IN CHILDREN BORN IN LOVE CANAL AREA

	Wet areas	%	Dry areas	%
Number of children born	120		176	
Number with birth defects (New York Health Dept. data)	15	12.5%	9	5.1%
Number with birth defects (residents' data)	24	20.0%	12	6.8%

Relative risk (residents' data) 2.9

chi square 12; probability that difference is due to chance is less than .001

Table 3

BIRTH DEFECTS IN CHILDREN BORN DURING LAST 5 YEARS IN WET AREAS

Children born	16
Number with birth defects	9
Percentage	56%

Central Nervous System Toxicity

In addition to causing birth defects, some of the toxic chemicals found in Love Canal are known central nervous system poisons. Lindane is found in the yards and in 75% of the sump pumps of homes in wet areas. Lindane causes hyperirritability and convulsions. Three other central nervous system poisons have been measured in the air of these homes; tetrachloroethylene, chloroform and trichloroethylene.

Central nervous system poisons can produce convulsions, loss of coordination, headaches, insomnia, hyperirritability and psychological depression. There is strong evidence that symptoms of central nervous system poisoning are occurring in the population surrounding the Love Canal. Each dot on this map (Figure 7) represents a nervous breakdown - either a suicide attempt or an admission to a mental hospital. I did not place on this map the many reports of "nervous condition". Most of the nervous breakdowns occurred in homes in wet areas. Those that occurred in dry areas (indicate on map) are very close to wet areas. This table (Table 4) shows that almost 9% of adults living in wet areas have had a nervous breakdown compared to 2.2% of adults living in dry areas in the southern section and 0.7% of adults living in dry areas in the northern section. The risk of an adult in the wet area having a nervous breakdown is 7 times the risk of all adults in dry areas.

Table 4

NERVOUS BREAKDOWNS

	Number of adults	Number of nervous breakdowns	%
Living in wet areas	149	13	8.7%
Living in dry areas-south section	226	5	2.2%
Living in dry areas-north section	284	2	0.7%

Relative risk wet areas to all dry areas: 6.9

chi square wet/dry south 8
probability that difference is due to chance is less than .005

Other Health Effects

Several chemicals in Love Canal are known to be toxic to the kidney and urinary system. This table (Table 5) shows that urinary disease occurs in 7% of persons living in homes in the wet areas as compared to 2.5% for homes in dry areas. These represent a variety of disease

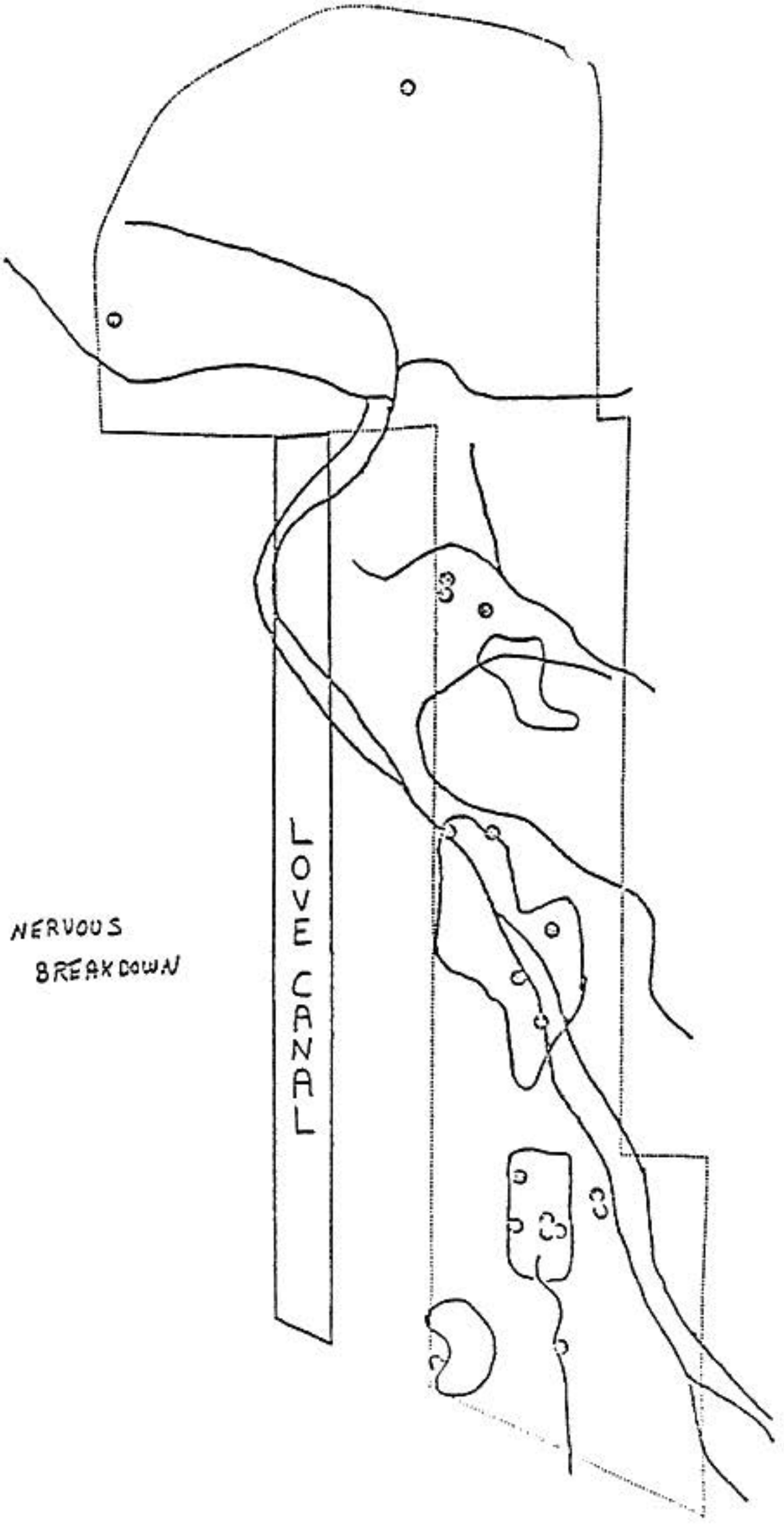

FIGURE 7.

including congenital malformations of the urinary system, loss of kidney function later in life, injured ureters or urethras leading to incontinence and severe, frequent bladder infections. Persons living in wet areas are 2.8 times as likely to have urinary disease as persons in dry areas. This map (Figure 8) shows the clustering of urinary disease in the wet areas.

Table 5

URINARY DISEASE IN LOVE CANAL AREA

	Number of people	Number with disease	%
Living in wet areas	314	22	7.0
Living in dry areas	826	21	2.5

Relative risk 2.8

chi square 13
probability that difference is due to chance is less than .0005

Respiratory disease of all types are common in the neighborhood. This table (Table 6) indicates that persons living in wet areas are 3.8 times as likely to have asthma as persons living in dry areas.

Table 6

ASTHMA IN LOVE CANAL AREA

	Number of people	Number with asthma	%
Living in wet areas	314	14	4.4%
Living in dry areas	826	11	1.3%

Relative risk 3.8

chi square 10
probability that difference is due to chance is less than .005

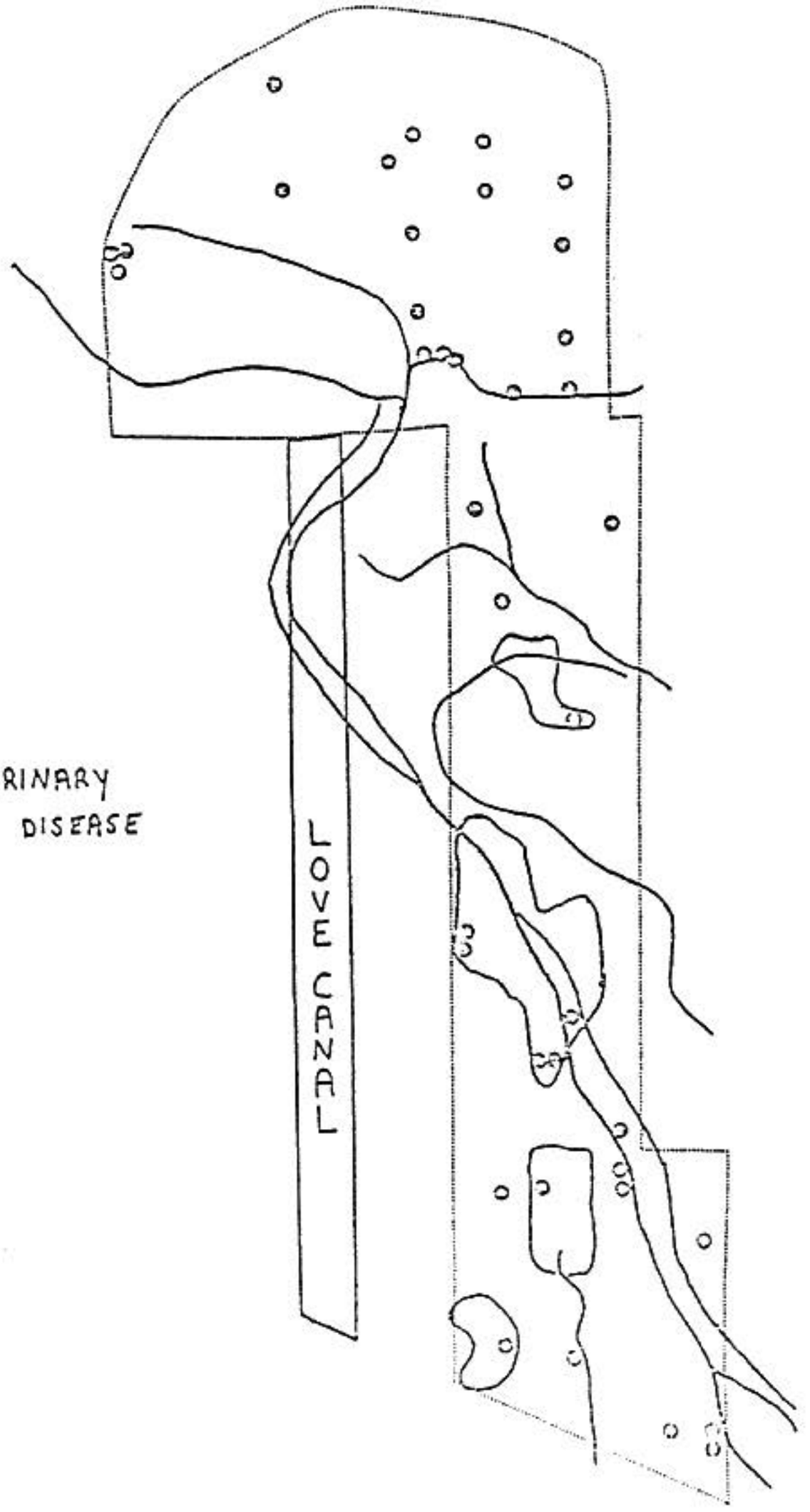

FIGURE 8.

Health Hazards for Which There is Probable Evidence

I would like to turn now to the health hazards that are probably resent but for which the data are less certain. If there are central nervous system poisons in the Love Canal neighborhood, then other types of central nervous system effects would be expected. My data indicate that the frequency of suicides, convulsive dosorders such as epilepsy, and hyperactivity in children are elevated. However, I have less confidence in these data due to the small number of cases or due to problems in diagnosis.

For instance, over the past 10 years 6 suicides have occurred in the Love Canal area when 1.7 would be expected for a population this size. Five of these 6 could be related to living in a wet area and the 6th may possibly be related. The 6th suicide occurred in a person who had lived directly along the canal for most of her life but had moved elsewhere in the neighborhood about a year before committing suicide. This increase in suicides is statistically significant; nevertheless a scientist feels uncomfortable working with such small numbers. Other medical studies have shown an increase in suicides in persons exposed to central nervous system poisons.

The data indicate an increased incidence of hyperactivity in children. I feel less confident about hyperactivity because this diagnosis can be misused but I think it is relevant that 11 of the 13 hyperactive children live in wet areas.

I also think it possible that chemicals in the Love Canal neighborhood may be causing convulsive disorders such as epilepsy. Twelve persons with a convulsive disorder live in the neighborhood. These are more likely to live in wet areas (chi square 3, probability that this difference is due to chance is less than 0.1). One.nine % of persons living in wet areas have epilepsy compared to 0.7% of persons living in dry areas, a relative risk of 2.7. Indeed one home whose basement air has one of the highest readings of tetrachloroethylene now houses 2 epileptics. This home is in a dry area but is obviously contaminated. It is also striking that most epilepsy has been diagnosed in the last 7 years, even in adults with no prior history of childhood convulsions and no other known medical cause of epilepsy.

Health Effects for Which There is Suggestive Evidence

In addition to these health effects, there are other health problems in the neighborhood that it has not been possible to evaluate statistically. These require further study. One is a very high frequency of skin disease. Second is a strong suggestion that the chemicals these people are exposed to may be interfering with their body's immune response. The residents report an unusual frequency of upper respiratory infections, pneumonia, and ear infections. In fact, several children have suffered some hearing loss due to constant ear infections. Third, there seems to be a definite impairment of the blood clotting system in these people. There are many reports of bleeding problems such as severe and frequent nosebleeds, unexplained uterine bleeding severe enough to require hysterectomy, and gastrointestinal or rectal bleeding for which physicans cannot find a cause.

Fourth, chemicals may be interfering with bone metabolism. Three ersons have Paget's disease which is a demineralization of the bone. cher bone problems are not diagnosed at this time. Fifth, several carcinogens are in Love Canal and I suspect that cancer is elevated in the area. Sixth, I believe that heart disease may be elevated in the area.

In this last map (Figure 9) I have superimposed many of the diseases I have talked about including miscarriages, birth defects, nervous breakdowns, hyperactive children, epileptics, and urinary disease. The concentration of disease is very heavy in certain areas. These data have led me to strongly recommend that the 140 families living in wet areas be evacuated immediately.

All of this evidence is statistical. It's important in establishing the magnitude of the problem, but it does not convey the human dimensions of what is involved. For that, I would like to tell you briefly about the history of one house in a wet area. This house is rented and 4 families have lived there during a 15 year period. In family number 1 the wife had a nervous breakdown and a hysterectomy due to uterine bleeding. In family #2, the husband had a nervous breakdown, the wife had a hysterectomy due to uterine cancer, the daughter developed epilepsy and the son asthma. In family #3, the wife had a nervous breakdown and both children suffered from bronchitis. In family #4, who lived there less than 2 years, the wife developed severe headaches after moving n the house. She also had a hysterectomy due to uterine bleeding and . premalignant growth

Health Studies of Evacuees

Epidemiological studies can never prove cause and effect; these studies only show an association of disease with geographical location. To obtain further information on whether these diseases are related to chemicals from Love Canal, we conducted a health survey on the people evacuated from rings 1 and 2 4 to 6 months earlier. I did not know what to expect since studies of people who have lived through disasters show an increased incidence of disease in the years following the disaster as a result of the stress. In addition, many toxic organic chemicals are stored in the body fat and tend to remain in the body for long periods of time.

As a result of these 2 factors, I did not expect much improvement in health after such a short time. One hundred and 1 families were surveyed. I was surprised to find that 67 reported a major improvement in health since moving (Table 7).

Table 7

HEALTH STATUS OF 101 EVACUATED FAMILIES

	Number of families reporting
Improved health	67
No change	34
Poorer health	0

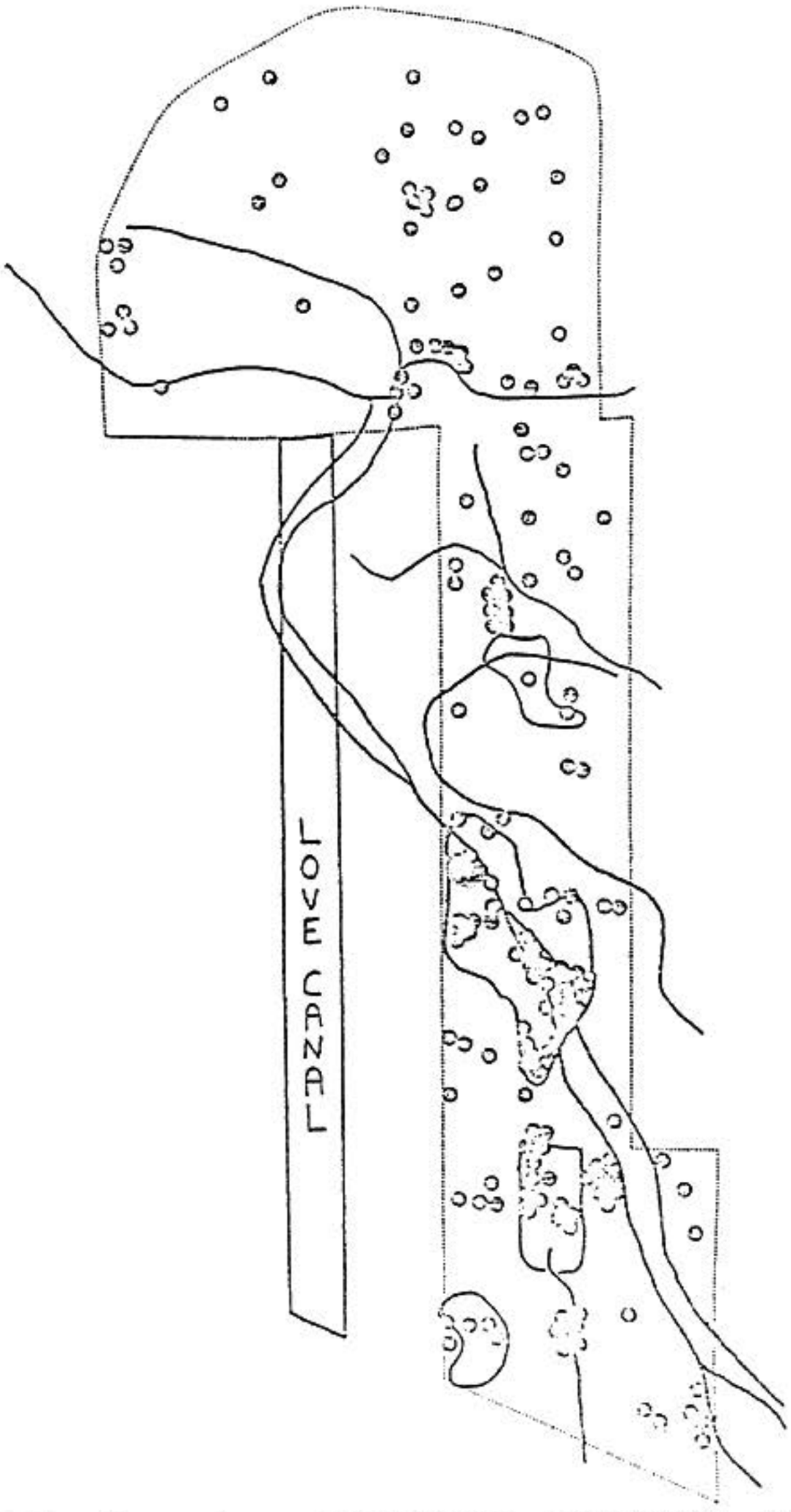

FIGURE 9. Miscarriages, still births, crib deaths, nervous breakdowns, hyperactivity, epilepsy, and urinary disease in Love Canal area.

Of the 9 families who reported that frequent ear infections was major problem while living on the canal, all 9 reported a major improvement in this problem. Of the 50 families who reported that colds, pneumonia, bronchitis and sinus infections were a major problem while living on the canal, 49 reported an improvement. Of 12 asthmatics, 11 reported an improvement; some of these have not had a single attack since moving. Of the 17 families who reported skin rashes as a problem, 14 have experienced improvement since moving. Of the 12 families who reported that severe depression or a nervous condition were health problems, 11 have reported major improvements. Of the 39 families that reported migraine or frequent headaches were a problem, 38 have reported a major improvement.

Table 8

HEALTH STATUS OF EVACUATED FAMILIES

Health Problem	Number of Families Responding	
	Improved Health	No Change
Ear infections	9	0
Upper respiratory infections	49	1
Asthma	11	1
Skin rashes	14	3
Depression	11	1
Headaches	38	1

One individual case is illuminating. One child had been extensively studied at Buffalo Children's Hospital for severe growth regardation. At age 3, she had a bone age of 1 year. Her doctors told the parents that they didn't know the cause of the growth retardation but that the child would probably be a midget. Since leaving the canal this child has begun to gain weight and grow rapidly.

I believe that even this limited survey of people who have been evacuated indicates a major improvement in the health problems can be achieved by evacuation despite the stress of loss of home and community.

In contrast, the people who have been left behind, particularly those who live in wet areas, are still facing a serious health hazard which they are powerless to correct without governmental action.

Recommendations

Based on these studies, I have made several recommendations:

(1) The 140 families living in wet areas in the section studied be evacuated immediately.

(2) All women of childbearing age who wish to have more children should be evacuated. They should be advised to wait 6 months to a year before getting pregnant to allow chemicals to be excreted from the body.

(3) Sick people who live in dry areas should be evacuated if they wish to move. There are some homes in dry areas with very high levels of chemical readings in their basement air and there are families in dry areas ill with multiple diseases. We do not know enough about what is occurring underground. Chemicals might be migrating along sewer pipes and service lines. Drums of toxic wastes may be buried in discrete areas separate from the Love Canal, as some truckers have claimed. Toxic wastes have migrated into the storm sewer system and these storm sewers back up and saturate yards with toxic chemicals.

(4) Detailed studies must be initiated on the west side of the canal where I have not done any health studies. A major swale runs through a housing development known as Griffin Manor. It touches 15 apartments. In fact, the entire Griffin Manor area was once low and swampy. It is possible that the area has been heavily contaminated. If it is, more families would have to be evacuated.

(5) The remedial construction work was planned before the importance of the stream beds was understood. It is important to modify the plan. Otherwise it may be that the construction of a drainage ditch parallel to the canal will simply lead to an increased flow of toxic waste down the stream beds.

(6) The stream beds may be so contaminated that they will have to be dug out, contaminated soil on either side removed, and drainage tiles be placed in each one. However, it may be necessary to abandon the entire neighborhood.

(7) Love Canal is as much a disaster as any hurricane, earthquake, or flood. The Federal government has accepted the responsibility of aiding areas hit by natural disasters. In 1977 our area in Western New York suffered a blizzard. Millions of dollars in aid were provided in response to the financial loss and inconvenience involved. Now we have a disaster that involves not only financial loss but also terrible health effects from a catastrophe that was totally beyond the control of the victims. They are trapped in a more serious and long-lasting way than any of us were by the blizzard. Their chemicals won't melt away in springtime. One of the neighborhood residents has expressed it very simply. He said, "I've been through a fire, I've been through a flood, and this is far worse"