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A REPORT TO THE U.S. CONGRESS ON THE HEALTH PROBLEMS OF RONGELAP PEOPLE

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Bravo - 1er Mars 1954. 1200 fois Hiroshima !!!

Evacuat° 72 heures après l'essai, après que les habitants
eurent des troubles sévères. (jusqu'en 1957)
Mis retour sur l'Atoll : avortements, accouchts prématurés,
anomalies congénitales, K thyr, Leucémies
N° générale de la santé

Nouvelle évacuat° proposée en 1985.

Cette étude tente d'aider les habitants dans leur décision
sur leur avenir. 4 questions :
Est-ce que la santé générale des habts de R. ~~est~~ connu une
évacuat° ou un maintient depuis 35 ans ?
Comment leur santé serait-elle affectée si ils revenaient
l'atoll ds les conditions actuelles ?
Y a-t-il des 2nes d'alt° sanitaire résiduelle actuelle chez les
exposés à de fortes doses en Mars 1954 et ds leur descend.s ?
Y a-t-il des elts de pb sanitaire liés aux radio chez ceux
n'ont pas subi les retombées de 1954 mais qui ont
vu sur l'Atoll après 1957 ?

TASK OF THE REPORT

This report is a preliminary evaluation of the health problems of the Rongelap people relative to the contamination of their air, water, land and food due to radioactive debris as a result of the Bravo blast. On March 1, 1954, the U.S. exploded a 15 megaton hydrogen bomb (more than 1,200 times as powerful as the Hiroshima bomb) without warning people in the inhabited islands downwind from the blast.

The Rongelap people began experiencing severe radiation sickness and were finally evacuated to Kwajalein Atoll 72 hours after the atomic test. They remained either on Kwajalein or Majuro Atolls until 1957 when their atoll was declared safe for habitation. However, the people began to experience health effects again that could be related to radiation exposure -- miscarriage, stillbirth, congenital defects in children, thyroid cancer and leukemia, together with a general deterioration in health.

In 1978 a Department of Energy radiological survey of the Marshalls indicated widespread and long-lived radioactive fallout. (See page 5 -- **DOE Estimates of Radiation Hazards on Various Marshall Island Atolls.**) The Rongelap people eventually were evacuated from their atoll in 1985.

This study attempts to assist the Rongelap people in making decisions about their future. The questions are asked:

1. Has the general health of the Rongelap people been improving, deteriorating or remaining stable over the last 35 years?

2. How would Rongelap people's health be affected if they moved back to Rongelap Atoll in its present condition?

3. Is there any indication of continued residual health damage in the Rongelap people exposed to high levels of radiation March 1, 1954 and in their offspring?

4. Is there any indication of radiation related health problems in Rongelap people who were not in the 1954 fallout, but who lived on Rongelap Atoll after 1957?

The health assessment presented here is based on medical examinations carried out on the Rongelap people by Dr. Brenda Caloyannis in January-February 1988, and on partial information on medical testing of the Rongelap people that was released to Dr. Bertell by Brookhaven National Laboratory in March 1988.

groupe DOE 1 : exposés en 1954. + leurs w

2 : revenus en 1957 + leurs w

3 : hors de l'échelle DOE

Dr. Caloyannis examined and interviewed 134 female and 113 male adult Rongelapese. Each was asked to identify whether or not he or she was in the Department of Energy (DOE) study group. If their answer was "yes", they were asked if they were in the "exposed" (to the 1954 fall-out) or "control" group (relocated to Rongelap in 1957). Children of those actually exposed in 1954 and children of the control group considered themselves in the same category as their parents. The DOE categories which are used for this analysis are as follows:

1. DOE exposed group (including their children)
2. DOE control group (including their children)
3. Not in DOE study group.

Caloyannis's findings have been organized to assist the reader with estimating the extent and severity of illnesses of the Rongelapese. There is a consistent pattern of more medical problems in almost every major disease category among the survivors of high nuclear fallout exposure, the DOE 1 group. Some illnesses show a graded effect with the DOE 2 group (exposed to residual radiation on Rongelap in the 1957-61 period) having an intermediate level of illness between the DOE 1 and those not in the DOE study (DOE Status 3). Island of residence has some overall significance for the health of the DOE Status 3 group.

The report begins with some brief responses to the questions of the Rongelap people.

TENTATIVE ANSWERS TO THE QUESTIONS POSED BY THE RONGELAP PEOPLE:

Question 1:

Has the general health of the Rongelap people been improving, deteriorating or remaining stable over the last 35 years?

Answer 1:

The health of the Marshallese over 35 years of age still reflects their experience in March 1954. It is obvious that the DOE Status 1 and perhaps also Status 2 Rongelapese are still disadvantaged healthwise compared to those not in the DOE study. (See explanation of DOE Status groups on previous page.) This latter group gives the best estimate for Rongelapese not exposed to significant nuclear fallout during the first ten years after Bravo. Probably all Rongelapese were exposed to chronic low dose radiation because of food contamination. The children of the high exposure group are showing a higher tendency to have tumours and cysts than their peers. Rongelapese have serious reproductive problems, and general physical abnormalities in children appear to be on the rise. Heart disease and diabetes need special medical analysis and programs. There is potential for improvement especially in the areas of maternal child health and infectious disease control. One cannot say that the Rongelap people's health has been improving over the last 35 years. In many important aspects such as the health of children there has been a worsening situation.

Question 2:

How would Rongelap people's health be affected if they moved back to Rongelap Atoll in its present condition?

Answer 2:

As can be seen on page 24, the children living on Rongelap Atoll (evacuated in 1985) experienced a high degree of ill health (about 42% with medical problems). Those children with parents in DOE Status 1 or 2 experienced about the same level of ill health regardless of place of residence. However, the children with parents not in the DOE study appear to have less illnesses (32% with medical problems) when not living on Rongelap Atoll. There appears to be an advantage for children, as would be expected, living on a less contaminated atoll. In younger women (age 16 to 34 years) the proportion experiencing reproductive loss, is less for those having never lived on Rongelap (12%) than for Rongelap Atoll residents (26%). The Atoll is not a good place for raising children.

Question 3:

Is there any indication of continued residual health damage in the Rongelap people exposed to high levels of radiation March 1, 1954 and in their offspring?

Answer 3:

Continuing abnormal health and reproductive problems in the survivors of the high level fallout March 1, 1954, is clearly demonstrated in this report. Determining the magnitude and extent of the problems will require further clinical confirmation and testing.

Question 4:

Is there any indication of radiation related health problems in Rongelap people who were not in the 1954 fallout, but who lived on Rongelap Atoll after 1957?

Answer 4:

The DOE Status 2 Rongelapese and their children are clearly having reproductive problems most likely related to their exposure to residual fallout on Rongelap Atoll. They also have heart diseases at a level comparable to that of DOE Status 1 Rongelapese. This may well be attributable to alpha particle damage to blood vessels. There are other indicators of possible radiation-related effects, but these will require medical testing for further clarification and determination of the magnitude and extent of the problems.

RECOMMENDATIONS

1. Development of a maternal/child health program to assess genetic and environmentally mediated reproductive problems, and to understand and compensate for the negative health trends observed in the Rongelap population. This will require further medical consultation with the Rongelap people and with medical specialists in a variety of categories.

2. In terms of future medical and health care delivery planning a much broader comprehensive study should be undertaken.

3. Release by Brookhaven National Laboratory of:

   a. Blood analyses for the DOE Status 1 (exposed) population and their children;

   b. Blood analyses for the children of the DOE Status 2 control population;

   c. The reports of blood chromosome tests done, apparently, on several of the exposed and control Rongelapese.

   It is important that this information be examined so that a reasonable follow-up can be designed.

4. Cytogenetic testing of Rongelapese both to clarify radiation exposure history and to predict.

5. The control population clearly shows blood abnormalities, with monocyte counts more severely on the low side in the earlier period 1957-1961, and on the high side in 1982-1986. This latter trend may be an indication that there will be a development of leukemia in these controls within the next few years.

6. It is our recommendation that all personal medical records on the Rongelap people which are now held by the U.S. government either at Brookhaven or elsewhere be immediately released to the Rongelap people.

TECHNICAL SUMMARY

MEDICAL EXAMINATIONS APRIL 1988

Dr. Caloyannis examined 544 people (297 children, 134 adult females, 113 adult males).

Notes from Dr. Caloyannis, April 1989: "Now I wish I had been there for three months to examine people from head to foot and at leisure. However, with the time constraints and distances involved, the project was primarily limited to the interview information, looking for glucosuria and hypertension in adults, and weights and measures in children. Therefore I didn't do, nor could I have done, complete physicals on all children."

Children:

We defined children as 15 years of age or younger. Of the children examined 104 or 38.3% were found to have medical conditions of concern (page 7). 41.3% of the children born on Rongelap or Majetto or evacuated with the Rongelap Community in 1985 reported health problems of concern, compared with 35.3% of those not born on Rongelap or Majetto or evacuated. 6.8% of the children examined had severe birth defects. When the place of birth in a child's record was the hospital in Ebeye or Majuro, the only hospitals in the Marshalls, we used evacuation from Rongelap as an indicator of the usual place of residence.

It should be noted that a number of children born with defects would not have survived.

Dr. Caloyannis: "Yes, we did really survey the survivors. It was hard to tell from history often what had led to perinatal deaths. Having watched the struggle of Downs babies to survive respiratory, cardiac and feeding difficulties in our own neonatal intensive care units, I can imagine that on small islands such babies could be born and expire without any diagnosis. I could not find out if pathology reports were available on any of the presumed mole pregnancies or reported "monster" births.

"Photos would have been useful for the gross appearance of some of these things, for later identification. Actually Dr. Lau [Dr. Bernie Lau, of Toronto, Ontario, Canada] said that he was told many photos were taken at Ebeye hospital and shown to visiting American investigators. They were said to have

burned the photos in front of the Marshallese and said 'This is what we think of your evidence.' If this is a Marshallese urban myth it is current and powerful.

"For better diagnostic success with the handicapped children, photographs of the faces, handprints, and a full physical description would help. Irene Uchida, a geneticist in the Hamilton-Toronto area, has a special interest in handprints. (Of course chromosome studies are also helpful.)"

Heart Murmurs

7.4% of the children examined had significant or potentially significant heart murmur (page 8). The actual proportion of children may be higher, since only 10 to 20% of the children were examined for heart problems. Some cases were probably missed.

Dr. Caloyannis: "I always listened if the Mom said there was a murmur, if there was a history of arthralgias, or if I saw a pectus deformity or a scoliosis.

"We did not determine hemoglobins on these house to house visits. Anemia would magnify the grading of murmurs, a low viscosity could upgrade a I/VI murmur to even possibly a III/VI. If blood testing is done on the children ever, hemoglobin should be done."

Adult Population

We define adult as 16 years or older. 134 females and 113 males were examined. Degree of exposure to radiation was categorized by DOE status (page 12). This includes the DOE exposed, i.e. those on Rongelap 1 March 1954, and the DOE control populations, returned, with the DOE exposed, to Rongelap in 1957.

The exposure categories used for analysis were:

1. DOE exposed (including their children)
2. DOE control group (including their children)
3. Those who were not in the DOE study group.

Illnesses were divided by etiology and major disease group (pages 11,12). The health problems of the three generations are examined separately later (page 27).

The proportion of MALES with medical problems increased with probable level of radiation exposure:

55.6%	DOE Status 3	
63.6%	DOE Status 2	
88.5%	DOE Status 1	(page 14)

When examining the groups of illnesses by DOE status some appeared randomly distributed over the three status groups; some appeared related only to high dose exposure; and some were apparently related to the three levels of radiation exposure, increasing with exposure.

Infectious diseases observed in 1988 and mental and neurological abnormalities did not appear dose related. They may have been dose related 30 years ago.

Tumours, thyroid problems and various medical problems have a higher rate in the DOE exposed group, but do not show a trend with the two lower dose groups.

A medical problem in adult men which appears radiation dose related is infertility. Those men actually on Rongelap during the 1954 fallout experienced 33.3% infertility. Their male children had an 11.8% infertility rate. The general infertility rate for Rongelap males between ages 16 and 34 (i.e. born after the 1954 fallout) was 1.8%. (See page 17).

As with the men, Rongelap WOMEN showed an increase in illness with an increased level of radiation exposure:

58.1%	DOE Status 3	
76.8%	DOE Status 2	
88.6%	DOE Status 1	(page 17)

Reproductive losses in the Rongelap women appear radiation related. These losses include miscarriage, neonatal loss and infant deaths up to one year of age. Those born after 1954 were first generation after the major fallout. In this report they are the young adults, 16 to 34 years of age. Their high rate of reproductive loss reflects a situation which is probably both genetic and environmentally mediated. There is an urgent need for a maternal child health program for Rongelap women and for cytogenetic testing. The Rongelap children in this report are the second generation after the Bravo event and recessive genetic damage may be becoming more prominent. This is a serious and urgent concern. The reproductive situation is not improving with time.

Sixty-six percent of the women in DOE Status 1 experienced reproductive loss. For DOE Status 2 it was 41%; and for DOE Status 3, it was 23% (page 22).

The children's DOE status has been defined according to their parents DOE status. The proportion of children with medical problems appears to be sensitive to island of residence as well as parental DOE status (page 24). There was more illness in the population living on Rongelap Atoll.

It appears that parental DOE status is an important factor in the level of ill health of children regardless of their place of residence. Residence is a more important factor for those children whose parents were not directly exposed to the fallout or residual radiation, i.e. neither parent in DOE Status 1 or 2.

The congenital, or from birth, medical problems may be either genetic or initiated while the child is in utero by some external factor. These types of illnesses are high in both DOE 1 and 2 Status children and may reflect environmental contamination (page 25).

There may be some indication that the congenital heart defects in the Rongelap children are related to exposure to radiation (page 26).

THE HEALTH OF THREE GENERATIONS IS LOOKED AT IN TERMS OF DOE STATUS

In examining the health of three generations of Rongelap people since the Bravo event it is apparent that congenital problems are occurring among the children at a higher rate than among their parents or grandparents (page 27). One expects the opposite trend. Marshallese have not enjoyed first world medical care, so it would not be credible to assume higher survival rate for those with congenital problems. Actually, survival is poor.

The data also shows that acquired and multiple factor medical problems both increase with age and are gradient with radiation exposure.

Analysis of health problems in terms of DOE status by etiology and disease groupings indicates that it is extremely unlikely that the consistent patterns of health problems related to age and DOE status are occurring by chance. There are clearly health problems related to parental DOE status, and clearly health problems related to living on the contaminated Rongelap Atoll.

The breakdown of health problems for three generations is central to this report (pages 28-32).

BROOKHAVEN MEDICAL TESTING

The analysis of the results of medical testing done on the Rongelap people and carried out by Brookhaven National Laboratory (BNL) is incomplete because crucial data has not been released by Brookhaven for analysis (page 34).

The data that has been released on the DOE control population strongly indicates that contamination was widespread and all of the islands may have received fall-out.

Depressed monocyte counts are seen in the Rongelap people regardless of whether or not they were on the Rongelap Atoll at the time of the Bravo event (page 35). Although BNL has only released data on blood for DOE Status 2 Rongelapese, they state that blood parameters were abnormal for this group prior to the 1957 relocation on Rongelap Atoll.

A comparison made between the DOE control population and other populations who have been exposed to radioactive chemicals in particulate form shows further the scientific unacceptability of the use by DOE of the Rongelapese who returned to the Atoll in 1957 as a control group. The monocyte counts for this group differ from those for a normal (no unusual exposure) population (Graph A, page 41), and are similar to abnormal counts for exposed populations in Malaysia and Canada (page 44 and Graphs E-G).

An additional problem with the acceptability of the control group data is that controls have been added over the years. This report urges that all BNL blood and blood chromosome data be released to the Rongelap people and their advisors.

Some additional comments from Dr. Brenda Caloyannis:

"I was raised on a farm near Uxbridge, Ontario. I did a B.A. in psychology at University of Toronto and then worked as a child care worker for many years. I did extra undergraduate work at University of Western Ontario. My only background training pertaining to radiation effects were courses in physics, genetics and biophysics, long ago. I graduated from McMaster family practise residence in 1982. I am licensed to practise in Ontario and Jamaica, and I am a member of the College of Family Physicians.

"While a medical student I worked and studied for three months in a rural hospital in Black River, Jamaica, and as a resident I worked for two months with Project Hope in inner city clinics in Kingston, Jamaica. This winter I spent four weeks at a more leisurely pace studying health problems and working in a drop-in clinic in Kingston.

"My practice in Ontario is located in Val Caron north of Sudbury. There are about 2300 patients of whom probably a thousand are 16 years and younger. I do 50-60 deliveries a year, about 2/3 of these are referred from outside the practice for prenatal care and delivery. I see a few more handicapped children than usual. Some are referred, some are part of the large number of children under care of the Children's Aid Society or the Young Offenders Act. In addition to office practice and deliveries, I do some house calls and a few emergency room shifts, sit on a hospital infection control committee and the community Child Abuse Review Team.

"While doing the Rongelap Health Survey in February 1988, I was most impressed by what seemed to be an increased number of children with congenital problems. The number of people were much smaller than my own practise, but there seemed to be more congenital heart disease and mental retardation syndromes with dysmorphic features than one would expect, clinically.

"First cousin marriage was not common among this group, the women frequently marrying men from far islands in preference to men known "too well" from childhood. As well, there are elaborate rules governing one's behaviour towards one's first cousins of the opposite sex, which also remove them from the realm of possible mates.

"In addition to the visible children, it was the consensus of the women that miscarriage and births of things that were possibly hydatidiform moles had increased since the atomic tests. In North American studies 50-60% of first trimester losses are due to chromosomal errors and about 33% of second trimester losses also. And of course the molar pregnancies fall into two groups of genetic error.

Thus, clinically, and historically, one has to wonder if there is not an increased burden of genetic damage sustained by the Rongelap people. Surely these things deserve more study. This report is the property of the Rongelap people, but as members of this planet I think we all had better pay attention to such indicators that we are harming ourselves. With respect to our gene pool, our past is our future."

MEET THE RONGELAP PEOPLE

For those who have never travelled to the Marshall Islands, a little background information might be helpful. For those who know the story well, please know that the new information begins on page 7.

The Republic of the Marshall Islands lies in the central Pacific Ocean between 4° and 14° north latitude, and 160° to 173° east longitude. It consists of two nearly parallel chains of coral atolls and islands, built on two underwater chains of volcanic mountains. An atoll is a necklace-like formation of coral islands around the rim of an underwater mountain. The interior of the chain is a clear lagoon, the centre of which contains the submerged mountain peak. Islands are isolated coral formations without a chain or sheltered lagoon. They are less desirable living spaces since the sheltered lagoon teems with sea life. The word island is also used for larger land bodies on atolls. Smaller formations are called islets.

The eastern Ratak (Sunrise) Chain consists of 15 atolls and islands. The western Ralik (Sunset) Chain consists of 16 atolls and islands. Together these two chains comprise 1,152 islands and islets dispersed over more than 500,000 square miles (roughly the size of the Canadian Province of Quebec or the combined area of the U.S. States of Louisiana, Arkansas, Mississippi, Alabama, Georgia, Florida, North and South Carolina, Tennessee, Kentucky and Virginia). It has a population of about 33,000, with a median age of 15 years.

The Marshalls have a hot and humid climate, averaging about 81° F, and seldom ranging below 70° F or above 92° F. Even when temperatures are high, cooling winds from the ocean provide comfortable relief.

For about 3,000 years, the Islands have been inhabited by Asian people. The first foreign power to seize control in the Marshalls was Germany in the late 19th century, though the Spanish were the first European visitors. It was used primarily as a shipping stop for fresh fruits, vegetables and drinking water.

The Japanese administered the Marshalls between 1914 and 1945. The U.S. began nuclear weapon testing in Bikini Atoll, Ralik Chain, in 1946, and had the entire Republic of the Marshall Islands declared a U.S. Strategic Trust Territory by the United Nations in 1947.

The land mass of the Marshalls is sandy coral reefs with virtually no elevation above sea level. This makes it exceedingly difficult to sight land from a small boat. The Marshallese have developed a highly sophisticated navigational method based on reading the formation of waves rather than stars. They rank among the world's best navigators.

The Marshall Islands established a Constitutional government, May 1, 1979, which incorporates a unique blend of American and British concepts. Its parliament, called the Nitijela, consists of elected Senators. There is also a Council of Iroji (Chiefs) which has mainly a consultative function.

More recently, finalized in 1985, the Republic of the Marshall Islands has negotiated a Compact of Free Association with the United States. This represents a significant step on its way to independent nationhood.

Rongelap Atoll (literally "big hole") is one of the most beautiful atolls of the Ralik chain. It lies about 100 miles downwind of the nuclear bomb site, Bikini Atoll. Routinely, the people of this atoll were evacuated before each U.S. Bikini Atomic blast of the relatively smaller type tested before the development of the hydrogen bomb. However, on March 1, 1954, the U.S. exploded a 15 megaton hydrogen bomb (more than 1,200 times as powerful as the Hiroshima bomb) at Bikini, and no one informed the Rongelap people. When the U.S. navy ship Gypsy stationed just off the tip of Rongelap was ordered away from the area because it was in the direct fallout pathway of this bomb, it also failed to inform the Rongelap people or assist them to evacuate.

There were 28 U.S. Air Force weathermen stationed on Rongerik Atoll (literally "little hole") slightly further away from Bikini than Rongelap. These men, including Gene Curbow, the senior weather technician, have publicly testified that they warned the detonation crew prior to the March 1, 1954 test that winds were blowing toward inhabited atolls.

After the sudden flash of light from the west on the morning of March 1, 1954, the Rongelap people heard several loud claps like thunder. Later the bright morning sky turned grey and a gritty ash fell out the sky on the people, the drinking water and the food.

Several days later, the Rongelap people were evacuated to Kwajalein Atoll. Many were experiencing severe radiation sickness, with burns and epilation (hair loss). Their blood counts were found to be severely depressed. They received medical care and were forced to remain away from their atoll until 1957, when it was declared safe for habitation.

Rongelap women began to experience many miscarriages, stillbirths and abnormalities in their children. From 1961 on, many Rongelapese developed thyroid cancer. In 1972, Lekoj Anjain, nephew of Senator Jeton Anjain, died of leukemia at age 19 years. He was one year old at the time of the Bravo event.

The Rongelap people felt that their health was deteriorating in spite of U.S. assurances and annual medical testing. The U.S. Department of Energy radiological survey of the Marshalls in 1978 confirmed their suspicions that the radioactive fallout was more widespread and more long-lived than they had been led to believe. Rongelap Atoll was almost as contaminated as Bikini and Enewetak, the sites of 66 nuclear tests.

In May 1983, President Amata Kabua and Senator Jeton Anjain introduced a resolution into the Nitijela calling for the evacuation of the Rongelap people. The resolution passed unanimously but the U.S. refused to assist the people with the evacuation. In May 1985 Greenpeace sent its flagship, the Rainbow Warrior, which evacuated the Rongelap people to Majetto Island in the Kwajalein Atoll.

The questions to be answered before the Rongelap people make decisions about their future are extremely serious. The present study is an attempt to assist them in this very difficult task.

Questions:

1. Has the general health of the Rongelap people been improving, deteriorating or remaining stable over the last 35 years?

2. How would Rongelap people's health be affected if they moved back to Rongelap Atoll in its present condition?

3. Is there any indication of continued residual health damage in the Rongelap people exposed to high levels of radiation March 1, 1954 and in their offspring?

4. Is there any indication of radiation related health problems in Rongelap people who were not in the 1954 fall-out, but who lived on Rongelap atoll after 1957?

THE RONGELAP ATOLL

In 1978 the U.S. Department of Energy undertook a study of the northern atolls of the Marshall Islands: Rongelap, Utrik, Taka, Bikar, Rongerik, Ailinginae, Likiep, Ailuk, Jemo, Mejit, Wotho, Ujelang and Bikini. They had done a similar study of Enewetak Atoll between 1972 and 1978.

Aerial surveys of gamma radiation were conducted. More than 5000 samples were taken of soil, water and food from plants, sea and land life. The findings were published in Marshallese in 1982 and the detailed measurements were published in English in June 1981 (U.S. Department of Energy EGG-1183-1758).

The results of the survey are given in Table 1. It is easy to see why the people of Rongelap became alarmed. Their atoll was contaminated to a degree comparable to that of Bikini and Enewetak, however, unlike those two atolls, Rongelap had been inhabited continuously between 1946 and 1954, and after 1957. The maximum hazard posed by the contaminated atoll would have been in 1957, with a gradual decrease in contamination to the reported level in 1978. The level of contamination decreases because of the radioactive decay process and because of natural weathering, rain and soil erosion.

DOE 1978 ESTIMATES OF RADIATION
HAZARDS ON VARIOUS MARSHALL ISLAND ATOLLS

Atoll or Island	Max. in any 1 year	Highest av. amt. 30 years	Highest av. amt. to bone marrow 30 years	Range uR/h at 1 metre	Cesium 137 component	Cobalt 60 component
Ujelang	20 mrem	130 mrem	150 mrem	0.20 to 0.22	none	none
Taka	20 mrem	140 mrem	170 mrem	0.42	none	none
Enewetak* (Enewetak, Japtan or Medren)	11 to 28 mrem(1) 24 to 51 mrem(2)	69 to 200 mrem 120 to 330 mrem	100 to 250 mrem 330 to 460 mrem			
Wotho	30 mrem	200 mrem	230 mrem	0.19 to 0.22	none	none
Enewetak* (Billae to Jemo)	50 mrem	330 mrem	390 mrem	0.22	none	none
Utrik	75 mrem	490 mrem	590 mrem	0.69 to 0.75	none	none
Likiep	75 mrem	530 mrem	580 mrem	0.19 to 0.22	none	none
Ailuk	90 mrem	650 mrem	680 mrem	0.19 to 0.25	none	none
Mejit	100 mrem	710 mrem	730 mrem	0.27	none	none
Bikar	210 mrem	520 mrem	1800 mrem	0.50 to 0.52	none	none
Enewetak* (Bijire or Aomon)	150 to 156 mrem(1)	960 to 990 mrem	1000 to 1200 mrem			
Ailinginae	270 mrem	1700 mrem	2100 mrem	1.5 to 1.9	1.4 to 2.5	none
Rongrik	270 mrem	1800 mrem	2100 mrem	4.8 to 7.5	4.1 to 7.6	0.3 to 0.5
Enewetak* (Bijire or Aomon)	294 to 303 mrem(2)	1700 to 1900 mrem	2200 to 2300 mrem			
Enewetak* (Enjebi)	300 to 561 mrem(3)	1800 to 2600 mrem	2300 to 3800 mrem			
Rongelap	400 mrem	2500 mrem	3300 mrem	4.1 to 43	4.6 to 42	1.7 to 3.0
Bikini*	1000 mrem to 1900 mrem	2300 mrem to 4000 mrem	2300 mrem to 4000 mrem	0.5 to 50	2.3 to 44 Av. 31 uR/h	0.2 to 9.0 Av. 1.9 uR/h
Enewetak* (Enjebi)	900 to 975 mrem(1) 1863 to 2010 mrem(2)	4600 to 4900 mrem 8500 to 9100 mrem	5100 to 5500 mrem 10,000 to 11,000 mrem			

* estimates depend on the availability of imported foods and use of local food
(1) imported food, with and without food from northern islands
(2) no imported food, with and without food from northern islands
(3) no imported food, but food supplement from the southern islands

SOME GENERAL INFORMATION ON THE HEALTH OF RONGELAP PEOPLE

In January-February 1988, Dr. Brenda Caloyannis, a physician with a large family practice in Sudbury, Ontario, went to the Marshall Islands to evaluate (within time and budgetary restraints) the current health of the Rongelap people. She knew nothing of the history of the Rongelap people and had no experience with a radiation-exposed population. Therefore we believe her medical assessments and reports are unbiased by any prior expectations. Dr. Caloyannis spent time on Majuro, Ebeye and Majetto Islands and examined 297 children, 134 adult females and 113 adult males. The forms used to record these examinations are appended to this report (Appendices I, II, III).

The data presented in this part of the report are from the 544 records prepared by Dr. Caloyannis. Medical decisions were made by her in consultation with Dr. Brian Gibson and Dr. Bernie Lau, consultants to IICPH. Dr. Lau also served for 9 months at the Ebeye Field Hospital in the Marshall Islands. Dr. Gibson is a medical toxicologist with the Toronto Department of Health.

This presentation of health findings is in two parts, the first being the presentation to the U.S. Congress 26 April 1988; the second part is a further detailed analysis of the medical data on the Rongelap adults and children.

PART I

PRELIMINARY REPORT TO THE U.S. CONGRESS - 26 APRIL 1988 -
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REPORT ON MEDICAL EXAMINATIONS OF RONGELAP CHILDREN - 1988

271 Children were examined and 104 (38.4%) were found to have medical conditions of concern. These conditions included:

Congenital diseases such as: Turner's Syndrome, 2 Down's Mosaics, Hydrocephalus, probable other mongoloid, pigeon chest, pectus excavatum, facial asymmetry, hip dysplasia, severe gait deformity, and hearing problems. One child was autistic and five had severe medical problems including convulsion, epilepsy and paralysis (which may or may not have resulted from an undiagnosed meningitis).

Acquired diseases such as: impetigo, purulent rhinorhea, frequent otitis, pneumonia, bronchitis, round worms, kidney infection, cervical nodes and other medical problems.

CHILDREN'S HEALTH PROBLEMS RELATIVE TO PARENTAL EXPOSURE:

Parents exposed 1 March 1954 on Rongelap: 83 medical problems were observed in 50 children (1.7 per child) among the 124 children with one or both parents exposed in 1954. This is 40.3% of the total children in this group.

Parents Not Exposed 1 March 1954 on Rongelap: 87 medical problems were observed in 58 children (1.5 per child) among the 147 children with neither parent exposed in the 1954 fallout. This is 39.5% of the total. The Grandparents of some of these children were on Rongelap, 1 March 1954.

Born on Rongelap or Majetto, or evacuated with Rongelap community in 1985: 57 children (41.3%) reported as having medical problems of concern.

Not born on Rongelap or Majetto and not evacuated in 1985: 47 children (35.3%) reported as having medical problems of concern.

There are no obvious signs of malnutrition for children living on Rongelap compared to those living on Ebeye or Majuro prior to 1985. However, children born since evacuation to Majetto appear abnormally short (Tables 1 and 2). See pages 9, 10.

SURGERY:

Only 4 of the 271 children had had surgery. They were all in the Rongelap community evacuated from Rongelap Atoll in 1985.

SEVERE PHYSICAL DEFORMITIES AND BIRTH DEFECTS:

These include one autistic child, 2 Down's mosaics and a probable mongoloid, Turner's syndrome, severe gait deformity, hydrocephalus, etc. It is likely that other children with severe defects died in utero or shortly after birth. No record of rates or causes of perinatal or infant death is available. There were 17 severe defects. (6.3% of the children), which is a very high proportion of surviving children in a country not equipped with heroic or even ordinary (by U.S. standards) medical facilities.

SIGNIFICANT OR POTENTIALLY SIGNIFICANT HEART MURMUR:

There were 20 (7.4% of the children) with this problem. The proportion of children in the United States with this defect is 2 to 3%. It should also be noted that not every child was examined for heart murmur. The proportion may be quite a bit higher because of unidentified cases. All non-examined children were assumed to be normal.

CONCLUSION:

The general health of the Rongelap children is precarious, requiring an environment conducive to improving health. They also require protection from extraordinary environmental hazards.

There is some indication that ill health is both more prevalent and more serious among the children born and/or brought up on the Rongelap Atoll. Further clarification of this finding is needed.

Dr. Caloyannis, who has a practice including about 900 children, in Sudbury, Ontario, and who has practiced medicine in Jamaica, found the prevalence of congenital medical problems among the Rongelap children startling.

TABLE 1

Average Height in Centimeters for
Rongelap Children

Island of Birth	AGE IN YEARS														
	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01
Rongelap:	145	142	142	143	128	123	117	115	119	102	97	95	--	--	--
Majetto:													86	73*	63*
Ebeye:	155		136	57	127	123	114	113	107	105	93	102	85	79	--
Other:	127	146	132	132	126	124	122	116	103	103	98	87	85	80	70

* May indicate malnutrition

TABLE 2

Average Weight in lbs.
for Rongelap Children

Island of Birth	AGE IN YEARS														
	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01
Rongelap:	95	88	93	90	67	59	51	47	44	39	36	36	--	--	--
Majetto:													30	20	18
Ebeye:	112	--	77	90	64	60	80	50	40	40	41	43	27	22	--
Other:	102	97	70	83	65	59	54	51	53	39	37	30	27	24	18

PART II

REPORT ON HEALTH PROBLEMS OF RONGELAP POPULATION

Dr. Caloyannis examined and interviewed 134 female and 113 male adult Rongelapese. Each was asked to identify whether or not he or she was in the Department of Energy (DOE) study group. If their answer was "yes", they were asked if they were in the "exposed" (to the 1954 fallout) or "control" group (relocated to Rongelap in 1957). As can be seen in the table, children of those actually exposed in 1954 and children of the control group considered themselves in the same category as their parents. The DOE categories which are used for this analysis are as follows:

1. DOE exposed group (including their children)
2. DOE control group (including their children)
3. Not in DOE study group.

Later in this report (pages 22-25) we looked at the first, second and third generations separately. We relied on each individual's self-reporting and also checked against the Four Island Health Care computer listing of Rongelap people.

DATA CHARACTERISTICS BY DOE STATUS

	1		2		3		Total	
	F	M	F	M	F	M	F	M
Total Population:	35	26	56	33	43	54	134	113
Average Age:	46	52	31	35	35	34	36	38
Minimum Age:	17	19	16	17	16	18	16	17
Maximum Age:	79	87	84	67	87	69	87	87

It should be noted that DOE Status 1 adults (i.e. those over 16 years of age) have a higher average age. There is an apparent deficit in living children in this group.

ILLNESSES IN ADULTS

Illnesses were divided in two basic ways:

First by etiology:

1. congenital;
2. either congenital or acquired;
3. acquired;
4. involving complex factors, some hereditary and some environmental.

Congenital diseases or abnormalities are present at birth and reflect genetic problems or maternal exposures during the pregnancy. The acquired and complex factor illnesses reflect life style and environment after birth.

Second by major disease groups:

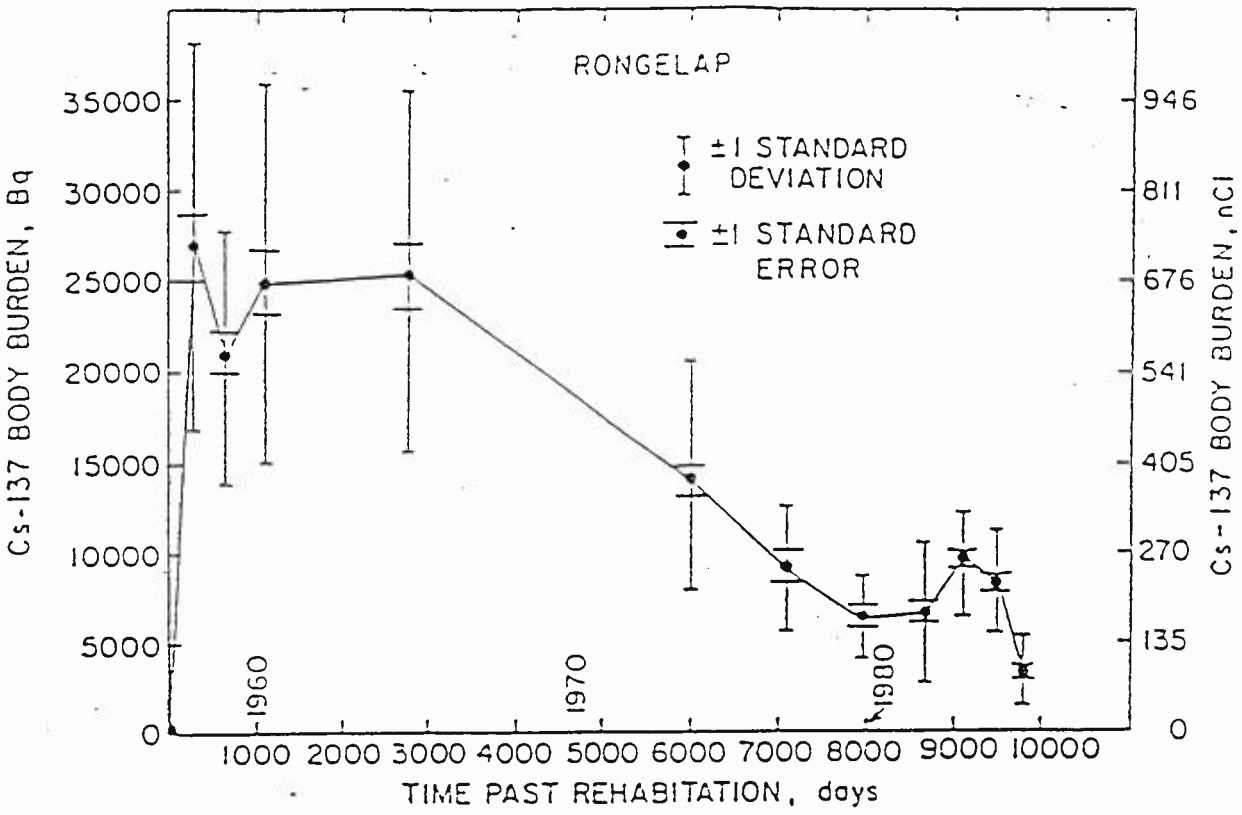
1. infectious diseases
2. reproductive problems
3. tumours or cysts
4. thyroid related
5. serious medical problems
6. other symptoms of ill health
7. general physical abnormalities
8. heart related
9. mental and neurological abnormalities.

Appendices IV and V give a listing of the diseases or conditions in each major category. The numbers of diseases or abnormalities reported per person differed by DOE category:

The **DOE EXPOSED GROUP** (**STATUS 1** in this report) had the highest level of radiation exposure with a whole body dose of about 190 rem over the two days following the 1954 Bravo test. This same group also returned to Rongelap Atoll in 1957, when it was still highly contaminated by today's standards. Their children of age 16 and higher are included in this group.

The **DOE CONTROL GROUP** (**STATUS 2** in this report) consists of Rongelap people and their children matched with the exposed group in sex and age, who returned with them to Rongelap Atoll in the July 1957 resettlement of the Atoll. They were exposed to a continuous intake of radioactive particles through the food chain as can be seen in the graph of cesium body burden in "time past rehabitation" taken from Dr. Henry I. Kohn's report, April 1988. (See Graph 1a, following page.) Cesium has a short biological half life, with 87% excreted in the first year after ingestion and 12% in the second year. The cesium remains in the environment with a physical half-life of almost 30 years. By the time of return to Rongelap in 1957, the dose received from the Bravo fallout in 1954 had been excreted, hence the graph starts at zero "body burden" and quickly climbs to between 25,000 and 30,000 Bq. The level at 10,000 days (27.3 years) after moving back to Rongelap is about the cesium level reached when the Atoll was evacuated for the second time in 1985. Cesium 137 does not occur naturally but is produced by a nuclear explosion.

#1a



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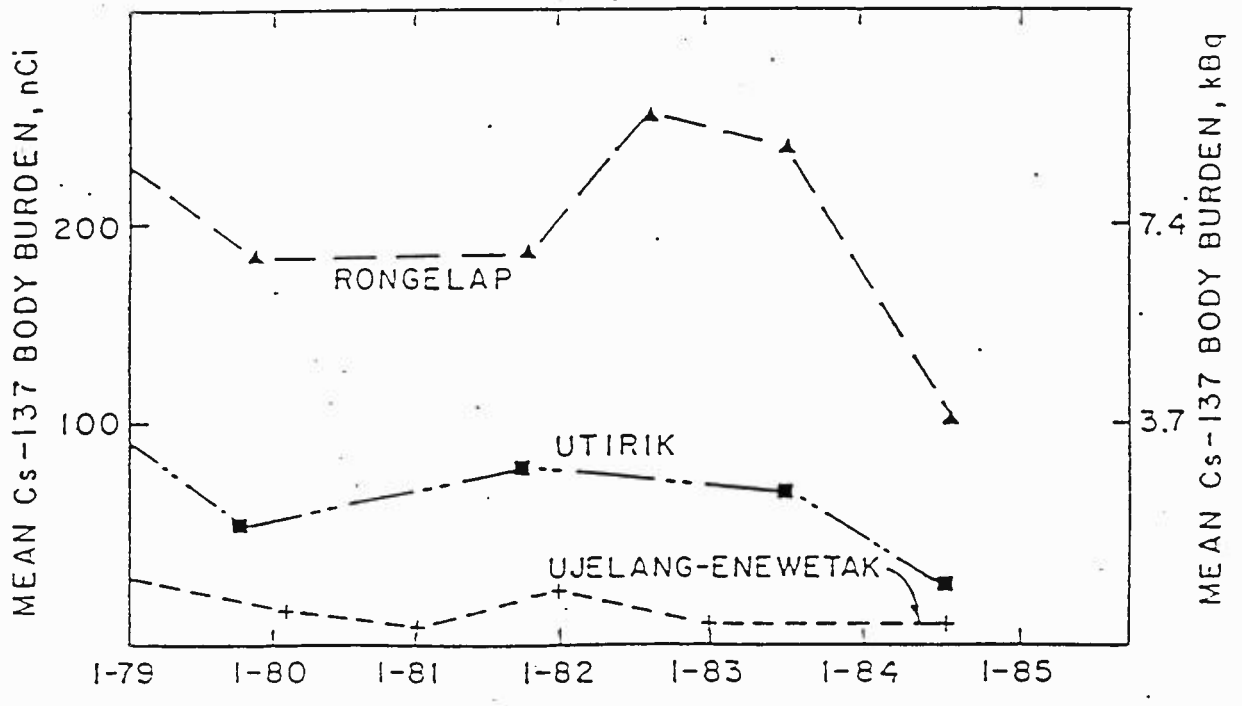


Fig. 4.3 #1. Adult cesium-137 body burden as a function of time (nCi/6= mrem).

About 20,500 Bq body burden for a 65 kg (143 lb) male would deliver a dose of 100 mrem a year. About 16,700 Bq body burden for a 54 kg (119 lb) female would give a dose of 100 mrem a year. This high dose from ingested cesium (that is, from cesium in food) continued for at least 3,000 days (eight years). Since the graph shows an average, some people received a much higher dose and some a much lower dose. Since the body burden did not decrease, there was a continuous ingestion with food affecting both the exposed (to fall-out) and the controls equally. The **DOE STATUS 2** population are considered exposed to an intermediate level of radiation, less than **DOE STATUS 1** but more than **DOE STATUS 3**

The second graph (1b) also shows the continued measurable level of cesium in food on the Rongelap Atoll to 1985. It is quite low compared to the 1957-1965 levels, but still higher than that on Utirik, attesting to the higher level of contamination from fall-out.

In addition to the internal cesium exposure both **DOE EXPOSED** and **DOE CONTROLS (STATUS 1 and 2)** were exposed to external gamma radiation from cesium 137 and cobalt 60 in the sand, and internal radiation from strontium, plutonium, americium and other transuranics produced by the nuclear explosions.

DOE STATUS 3 in this report consists of Rongelap people who are not seen regularly by the DOE physicians. They are presumed to have had the lowest exposure to ionizing radiation since they were not moved onto the contaminated atoll in 1957. However, the Rongelap people are highly mobile and many chose to live on their beautiful ancestral atoll. DOE frequently lost their controls to follow-up and chose new controls rather arbitrarily. This would dilute the DOE Status 2 category, but not introduce a bias toward falsely reporting a radiation gradient.

HEALTH OF ADULT MEN

The proportion of males with medical problems increased with probable level of radiation exposure.

	DOE STATUS 1	2	3	All
Average Age	52	35	34	38
% with medical problems	88.5 (23/26)	63.6 (21/33)	55.6 (30/54)	65.6 (74/113)
Average # problems per person	1.7	1.3	1.5	1.5

The higher average age in DOE Status 1 apparently indicates a deficit in living children for this group.

The proportion of the males with various medical problems organized by etiology revealed a very high level of acquired rather than congenital (from birth) problems with some indication of a trend toward increase with radiation exposure.

PERCENTAGE OF ADULT MEN WITH MEDICAL PROBLEMS BY ETIOLOGY

	DOE STATUS 1	2	3	All
Congenital	15.4 (4/26)	12.1 (4/33)	7.4 (4/54)	10.6 (12/113)
Cong. or acquired	50.0 (13/26)	15.2 (5/33)	8.5 (10/54)	24.8 (28/113)
Acquired	80.8 (21/26)	54.5 (18/33)	46.3 (25/54)	56.6 (64/113)
Multi-factorial	3.8 (1/26)	----	9.3 (5/54)	5.3 (6/113)

PERCENTAGE OF ADULT MEN WITH MEDICAL PROBLEMS BY DISEASE GROUPS:

When examining the groups of illnesses by DOE status some appeared randomly distributed over the three status groups; some appeared related only to high dose exposure; and some were apparently related to the three levels of radiation exposure, increasing with exposure.

MEDICAL PROBLEMS IN ADULT MEN WHICH APPEAR RANDOMLY DISTRIBUTED (1988)

	DOE STATUS 1	2	3	All
Infectious Diseases	3.8% (1/26)	3.0% (1/33)	5.6% (3/54)	4.4% (5/113)
Mental and Neurological Abnormalities	3.8% (1/26)	6.1% (2/33)	1.9% (1/54)	3.5% (4/113)

MEDICAL PROBLEMS IN ADULT MEN WHICH APPEAR RELATED PRIMARILY TO HIGH RADIATION DOSE EXPOSURE FROM THE 1954 BRAVO EVENT

	DOE STATUS 1	2	3	All
Tumours	7.7% (2/26)	3.3% (1/33)	5.6% (3/54)	5.3% (6/113)
Thyroid Problems	23.1% (6/26)	----	7.4% (4/54)	8.8% (10/113)
Serious Medical Problems	50.0% (13/26)	30.3% (10/33	37.0% (20/54)	38.1% (43/113)

These three categories do not show a trend with dose. However it is clear that males in DOE exposed group have a higher rate of medical problems in these disease groups. This may be an artifact caused by the grouping process or high male mobility. It may also reflect the higher average age of the **DOE STATUS 1** (exposed) group. For example, of the six persons reporting tumours or cysts five were born before 1954, i.e. they were exposed to some level of fall-out at the time although they were not on Rongelap Atoll. We will deal specifically with age in a later part of this report.

Other disease categories showed a graded effect consistent with a graded level of radiation exposure.

MEDICAL PROBLEMS IN ADULT MEN WHICH APPEAR RADIATION DOSE RELATED

	DOE STATUS 1	2	3	All
Infer-tility	19.2% (5/26)	3.0% (1/33)	----	5.3% (6/113)
Gen'l Phys. Abnorm'ties	7.7% (2/26)	6.1% (2/33)	5.6% (3/54)	6.2% (7/113)
Heart Problems	15.4% (4/26)	9.1% (3/33)	7.4% (4/54)	9.7% (11/113)
Other Symptoms	57.7% (15/26)	27.8% (9/33)	22.2% (12/54)	31.9% (36/113)

Each of these groups of medical problems exhibits a proportion of DOE controls intermediate between the level of medical problems in DOE exposed and those not in DOE. They are potentially related to exposure to residual radiation.

The infertility rate of our sample of men actually on Rongelap during the 1954 fallout was a startling 33.3%. The children of the DOE Status 1 males had an infertility rate of 11.8%. The general infertility rate in males 16 to 34 years was only 1.8%. This appears to be a clearly radiation-related phenomenon and requires further documentation. It is an especially sensitive and distressing problem for men.

The last category, Other Symptoms of Poor Health, includes abdominal pain, body aches, bursitis, chronic cough, diarrhea, ascaris, dizzy spells, fatigue or lack of energy, headaches, alcohol or tobacco addiction, and obesity. These can be very debilitating.

HEALTH OF ADULT WOMEN

As with the men, Rongelap women showed an increase in illness with increased level of radiation exposure. It is not clearly age-related since the average age of DOE Status 2 (controls) is less than those not in DOE, DOE Status 3.

	DOE STATUS			
	1	2	3	All
Av.Age (years)	45	32	36	37
% with Medical Problems	88.6 (31/35)	76.8 (43/56)	58.1 25/43)	73.9 (99/134)
Av.no.of Problems per person	2.3	1.8	1.7	1.9

PERCENT WITH MEDICAL PROBLEMS BY ETIOLOGY

	DOE STATUS 1	2	3	All
Congenital	11.4 (4/35)	3.6 (2/56)	2.3 (1/43)	5.2 (7/134)
Cong. or acquired	45.7 (16/35)	39.3 (22/56)	34.9 (15/43)	39.5 (53/134)
Acquired	82.9 (29/35)	58.9 (33/56)	44.2 (19/43)	60.4 (81/134)
Multi-factorial	60.0 (21/35)	35.7 (20/56))	18.6 (8/43)	36.6 (49/134)

The proportion of women with various medical problems organized by etiology revealed again a very high level of acquired rather than congenital (from birth) problems, with some indication of a trend toward increased proportion of ill health with increased radiation exposure.

REPRODUCTION AND GYNECOLOGICAL PROBLEMS

The matter uppermost in the minds of the Rongelap people is the survival and health of their children. This concern arises from their experience of increased miscarriage, stillbirth and infant death rates after the 1954 Bravo test. Because early miscarriages are often not recognized, we are including women who were infertile in the reproductive loss category. It is most likely that they tried to become pregnant and suffered very early embryonic loss or resorption. Also, it is to be noted that we are counting women who have had miscarriages or women who had stillbirths or infant deaths, not the number of reproductive losses women had in each category.

PERCENT OF WOMEN EXPERIENCING REPRODUCTIVE LOSS

	DOE STATUS 1	2	3	All
Infertility	----	3.6 (2/56)	2.3 (1/43)	2.2 (3/134)
Miscarriage	42.9 (15/35)	26.8 (15/56)	11.6 (5/43)	26.1 (35/134)
Neonatal Death	25.7 (9/35)	8.9 (5/56)	4.7 (2/43)	11.9 (16/134)
Post Neonatal Death (to one year)	20.0 (7/35)	5.4 (3/56)	2.3 (1/43)	8.2 (11/134)

There is an obvious serious reproductive problem which appears to be radiation related.

Because of the importance of reproduction we analyzed the reproductive data in several different ways. For these studies we counted women who experienced any reproductive loss, either miscarriage, neonatal or infant death. Each woman may have had more than one such experience. Infertility reports were not counted in this analysis.

REPRODUCTIVE LOSSES RELATIVE TO THE BRAVO EVENT

1. Women born before the Bravo Event (March 1, 1954)(35 years old or more):

On Rongelap March 1, 1954: (DOE Status 1)	69%	20/29
Relocated on Rongelap in 1957: (DOE Status 2)	66.7%	10/15
Not in DOE Study (DOE Status 3)	28.6%	4/14

2. Women born between 1954 and 1976 (16 to 34 years old):

Indicated period of residence on Rongelap Atoll	26.2%	11/42
Indicated no period of residence on Rongelap Atoll	11.8%	4/34

The women born after 1954 and who lived on Rongelap were first generation after the major fallout. Their high rate of reproductive loss reflects a situation which is probably both genetic and environmentally mediated. There is an urgent need for a maternal child health program for Rongelap women and for cytogenetic testing. The Rongelap children in this report are the second generation after the Bravo event and recessive genetic damage may be becoming more prominent. This is a serious and urgent concern. The Rongelap reproductive experience is not independent of island of residence. Problems of reproduction in those now children may become even more serious in the future.

In addition to reproductive problems, 6.7% (9/134) of the Rongelap women have gynecological problems including: ovarian cancer, pelvic inflammatory disease, ectopic pregnancy, cervical dysplasia, hysterectomy, and need for Caesarian birth. These appear randomly distributed but also require medical attention.

NON-REPRODUCTIVE ILLNESSES

The Rongelap women showed a similar pattern of medical problems to that of the males. Three categories were identified: (1) those which appeared randomly distributed, (2) those which appeared to be related to high dose exposure only, and (3) those which appeared radiation dose related. In these tables all adult women (16 years and older) are included.

MEDICAL PROBLEMS IN WOMEN WHICH APPEAR RANDOMLY DISTRIBUTED IN 1988:

	DOE STATUS 1	2	3	All
% of Women with Serious Medical Problems	34.3 (12/35)	41.1 (23/56)	32.6 (14/43)	36.6(49/134)

This is a very high level of ill health in women of average age 37. It should be noted that reproductive experience is not included in this figure but only those problems identified in Appendix V as **serious medical problems.** This is similar to Rongelap adult males, of average age 38, 38.1% of whom had **serious medical problems.**

MEDICAL PROBLEMS IN WOMEN WHICH APPEAR RELATED PRIMARILY TO HIGH RADIATION DOSE EXPOSURE

PERCENT OF WOMEN WITH MEDICAL PROBLEMS

	DOE STATUS 1*	2	3	All
Infectious Disease	17.1 (6/35)	1.8 (1/56)	2.3 (1/43)	6.0 (8/134)
Tumours	31.4 (11/35)	3.6 (2/56)	9.3 (4/43)	12.7 (17/134)
Thyroid Related	62.9 (22/35)	10.7 (6/56)	20.9 (9/43)	27.6 (37/134)
Other Symptoms	45.7 (16/35)	25.0 (14/56)	27.9 (12/43)	31.3 (42/134)

* Those in the DOE exposed group clearly experience these medical problems in excess of the other two DOE groups.

MEDICAL PROBLEMS IN WOMEN WHICH APPEAR RELATED TO RADIATION EXPOSURE DOSE

PERCENT OF WOMEN WITH MEDICAL PROBLEM

	DOE STATUS 1	2	3	All
Reproductive	65.7 (23/35)	41.1 (23/56)	23.3 (10/43)	41.8 (56/134)
General Phys. Abnormality	8.6 (3/35)	1.8 (1/56)	----	3.0 (4/134)
Heart Problem	17.1 (6/35)	7.1 (4/56)	4.7 (2/43)	9.0 (12/134)

*Note: DOE Status 1, 2, and 3 here include adult women and their adult female children.

The DOE controls and their daughters appear to have intermediate levels of ill health in these illness groups to that of the DOE exposed and those not in DOE.

SUMMARY OF ADULT HEALTH PROBLEMS

REPRODUCTION:

Reproductive loss is a continuing and serious problem for the Rongelap people. It also appears related to Atoll or Island of residence and to level of exposure to ionizing radiation.

This effect is not limited to those persons who received a high dose on March 1, 1954, but is affecting their children and the control group who lived on the contaminated Atoll.

HIGH DOSE RADIATION EFFECTS

There is a clear excess of a wide variety of medical problems in the DOE exposed population which cannot be explained entirely by their higher average age.

PERCENT ADULTS WITH ONE OR MORE MEDICAL PROBLEMS IN THE CATEGORY

	DOE Exposed (Status 1)	Not Exposed (Status 2 & 3)
Infectious Diseases	11.5 (7/61)	3.2 (6/186)
Tumours	21.3 (13/61)	5.4 (10/186)
Thyroid Diseases	45.9 (28/61)	10.2 (19/186)
Serious Medical Probs.	41.0 (25/61)	36.0 (67/186)
Other Symptoms of Poor Health	50.8 (31/61)	25.3 (47/186)

It is beyond the scope of this report to ascertain whether the Status 2 and 3 adult Rongelapese have a higher level of ill health than other Marshallese. In terms of future medical and health care delivery planning a much broader comprehensive study should be undertaken. The level of serious medical problems in these two groups (with average age 34 years) is itself quite alarming.

DETAILED EXAMINATION OF HEALTH PROBLEMS OF RONGELAP CHILDREN

The April 1, 1988 testimony to the U.S. House of Representatives Committee on Appropriations gives a general picture of the serious health problems experienced by Rongelap children, age 15 years or under. With such a high level of reproductive loss among Rongelap adults, it is to be expected that there will be an increased proportion of damaged surviving children. Stated another way, some of the damaged children will survive beyond the first year.

This more detailed examination of the health of the children is organized to correspond as closely as possible with the adult status categories. The children are divided as follows:

Status 1: One or both parents are in DOE Status 1 (exposed);

Status 2: Neither parent is DOE Status 1; and one or both parents are DOE Status 2;

Status 3: Neither parent is DOE Status 1 or DOE Status 2;

Status 4: Parent's DOE Status is unknown.

According to their island of birth, 78 children were born on Rongelap, 112 on Ebeye, 62 on Majuro, 8 on Majetto, 21 on other islands or atolls and 16 were unknown. Since the place of birth sometimes given was the hospital on Majuro or Ebeye (the only two

hospitals in the Marshall Islands), we also looked at whether or not the child was evacuated from Rongelap to Majetto in 1985. In our sample of 297 children, 98 had been evacuated, 173 had not been in the evacuation, and the evacuation category of 26 children was unknown.

GENERAL CHARACTERISTICS OF THE CHILDREN

	CHILD DOE STATUS 1	2	3	4	All
Number	59	81	84	73	297
Av.Age (years)	10	8	8	8	9
Sex Ratio (m/f x 100)	136	95	133	92	111
% with Medical Problems	42.4 (25/59)	42.0 (34/81)	27.4 (23/84)	34.2 (25/73)	36.0 (107/297)

The proportion of children with medical problem appeared to be sensitive to island of residence as well as to parental DOE status. For children in DOE Status 1 or 2 it appeared to make little difference whether or not they lived on Rongelap (were evacuated in 1985 or not). 42.4% and 42.0% respectively had medical problems. However the proportion in the DOE Status 3 and 4 groups appeared to be affected by residence. 40% for those evacuated as against 31.8% of those not evacuated had medical problems.

PERCENTAGE OF CHILDREN WITH MEDICAL PROBLEMS

	CHILD DOE STATUS 1	2	3 & 4	All
Evacuated 1985	43.3 (13/30)	42.1 (16/38)	40.0 (12/30)	41.8 (41/98)
Not Evacuated 1985	41.7 (10/24)	43.6 (17/39)	31.8 (35/110)	35.8 (62/173)
Evac. Status Unknown	40.0 (2/5)	25.0 (1/4)	5.9 (1/17)	15.4 (4/26)
All	42.4 (25/59)	42.0 (34/81)	30.6 (48/157)	36.0 (107/297

It appears that parental status is an important factor in the level of ill health of children regardless of their place of residence. Residence is a more important factor for those children whose parents were not directly exposed to the fall-out or residual radiation, i.e. neither parent in DOE Status 1 or 2.

The medical problems in children were examined by the same etiology and disease groupings as were used for the adults.

PERCENTAGE OF CHILDREN WITH MEDICAL PROBLEMS BY ETIOLOGY

	CHILD DOE STATUS				
	1	2	3	4	All
Congenital	15.3 (9/59)	21.0 (17/81)	8.3 (7/84)	8.2 (6/73)	13.1 (39/297)
Either Cong. or Acquired	8.5 (5/59)	7.4 (6/81)	9.5 (8/84)	12.3 (9/73)	9.4 (28/297)
Acquired	33.9 (20/59)	25.9 (21/81)	20.2 (17/84)	23.3 (17/73)	25.2 (75/297)
Multi-factorial	1.7 (1/59)	----	1.2 (1/84)	----	0.7 (2/297)

The congenital, or from birth, medical problems may be either genetic or initiated while the child is in utero by some external factor. These types of illnesses are high in both DOE 1 and 2 status children and may reflect environmental contamination.

The children's medical problems were also grouped into the same disease groupings as the medical problems of the adults. Only one child of the 297 had a medical problem related to reproduction so this category was eliminated. The general findings within disease categories is as follows:

	DOE STATUS 1	2	3	4	All
Infectious Disease	15.3 (9/59)	21.0 (17/81)	15.5 (13/84)	16.4 (12/73)	17.2 (51/297)
Tumours Nodules	1.7 (1/59)	2.5 (2/81)	1.2 (1/84)	1.4 (1/73)	1.7 (5/297)
Thyroid Related	1.7 (1/59)	----	2.4 (2/84)	----	1.0 (3/297)
Serious Medical Problems	10.2 (6/59)	7.4 (6/81)	6.0 (5/84)	9.6 (7/73)	8.1 (24/297)
Gen'l Phys. Abnormal-ities	6.8 (4/59)	7.4 (6/81)	6.0 (5/84)	4.1 (3/73	6.1 (18/297)
Heart	6.8 (4/59)	13.6 (11/81)	3.6 (3/84)	4.1 (3/73)	7.1 (21/297)
Mental or Neurological	1.7 (1/59)	----	1.2 (1/84)	----	0.7 (2/297)
Other Symptoms	18.6 (11/59)	4.9 (4/81)	3.6 (3/84)	11.1 (8/73)	8.8 (26/297)

As can be seen, there is a relatively high number of children with serious medical problems and with heart problems.

Some medical problems occurred only with the evacuated children: multiple organ systems malfunctioning, autism, anemia, arthritis, arthralgia, epilepsy, Down's syndrome. facial asymmetry, loss of nasal bridge, and meningitis. The two Down's mosaics, the child with pectus excavatum and the child with organomegaly were not among the evacuated.

Children with heart related problems appeared to be more frequent among the evacuated, 9.2% (9/98), than among the children not evacuated, 6.9% (12/172). Heart disease in children has been associated with parental occupation as a radiologist. ("National Survey of Congenital Malformations Resulting from Exposure to Roentgen Radiation" by Stanley Macht, M.D., American Journal of Roentgenology 73: 442-466, 1955.)

A LOOK AT THE HEALTH OF THREE GENERATIONS

Age Groups:

1. Those < 16 years of age in 1988.
2. Adults (16 years to 34 years in 1988) born since the 1954 Bravo event.
3. Adults born before the 1954 Bravo event. They were alive at the time of the fall-out, and were over 34 years in 1988.

There were 52 adults whose DOE status was known but birth date was not known. They are included in the totals, but not the intergenerational comparisons. The 73 children whose parental DOE status was unknown are also omitted from this section of the report.

DOE Status:

1. Exposed to the Bravo fallout, children or grandchildren of the exposed;
2. DOE controls, their children and grandchildren;
3. Adults or children not in DOE study population.

The total number of persons in each category who were examined by Dr. Caloyannis is as follows:

		DOE Status			
Age Groups/DOE:		1	2	3	Total
< 16	1:	59	81	84	224 *
16-34	2:	13	48	51	112
> 34	3:	36	20	27	83
Unknown	4:	12	21	19	52
Totals:		120	170	181	471

* 73 children whose parental DOE Status was unknown were omitted.

Congenital problems (present from birth) are clearly occurring among the children at a higher rate than among their parents or grandparents. There is also a clearly higher rate of congenital

problems among DOE exposed and controls (i.e. among those who lived on Rongelap in 1954 and/or 1957) and their children than among Rongelap people not in the DOE study. The total number of children in each of the above categories is large enough to indicate the trend is real. Examination of the category: either congenital or acquired further reinforces the association and does not indicate a problem with respect to misclassification of illnesses.

	NUMBER OF PERSONS				% OF PERSONS IN EACH CATEGORY			
DOE:	1	2	3	Total	1	2	3	Total
ETIOLOGY								
1: Congenital:								
15 or under	9	17	7	39	15.3	21.0	8.3	17.4
16 to 34	--	1	1	2	--	2.1	2.0	1.8
35 or over	2	--	--	2	5.6	--	--	2.4
	13	20	8	47*	10.8	11.8	4.4	10.0
2. Either Cong. or Acquired:								
15 or under	5	7	7	28	8.5	8.6	8.3	12.5
16 to 34	3	15	10	28	23.1	31.3	19.6	25.0
35 and over	20	8	13	41	55.6	40.0	48.1	49.4
	34	37	35	115*	28.3	21.8	19.3	24.4
3. Acquired:								
15 or under	18	21	16	72	30.5	25.9	19.0	32.1
16 to 34	6	26	19	51	46.2	54.2	37.3	45.5
35 and over	34	12	17	63	94.4	60.0	63.0	75.9
	67	73	61	218*	55.8	42.9	33.7	46.3
4. Multiple Factors:								
15 or under	1	--	--	1	1.7	--	--	0.4
16 to 34	3	10	7	20	23.1	20.8	13.7	17.9
35 and over	13	6	5	24	36.1	30.0	18.5	28.9
	24	21	15	60*	20.0	12.4	8.3	12.7

*** Note: Throughout these tables, the adults of unknown birth date are included in the totals only.**

In contrast to congenital problems, the proportion of persons with medical problems acquired and those with multiple factors increases with age. They also show a gradient with radiation exposure.

The data rather clearly demonstrates a higher proportion of congenital problems in the youngest group of Rongelap people, and the largest proportion of ill health in the DOE exposed category even within matching age groups.

A look at three generations with respect to the number and proportion with illnesses in each disease group:

	NUMBER OF PERSONS				% OF PERSONS IN EACH CATEGORY			
DOE:	1	2	3	Total	1	2	3	Total
1. Infectious:								
15 and under	9	17	13	51	15.3	21.0	15.5	22.8
16 to 34	1	2	3	6	7.7	4.2	5.9	5.4
35 and over	6	2	1	9	16.7	10.0	3.7	10.8
	18	23	17	70*	15.0	13.5	9.4	14.9
2. Tumours and cysts:								
15 and under	--	2	1	4	--	2.5	1.2	1.8
16 to 34	2	2	4	8	15.4	4.2	7.8	7.1
35 and over	9	1	2	12	25.0	5.0	7.4	14.5
	13	5	8	27*	10.8	2.9	4.4	5.7
3. Thyroid-Related:								
15 and under	1	--	1	2	1.7	--	1.2	0.9
16 to 34	--	4	6	10	--	8.3	11.8	8.9
35 and over	21	1	5	27	58.3	5.0	18.5	32.5
	28	6	15	49*	23.3	3.5	8.3	10.4
4. Serious Med. Problems:								
15 and under	6	6	5	24	10.2	7.4	6.0	10.7
16 to 34	3	14	10	27	23.1	29.2	19.6	24.1
35 and over	19	8	13	40	52.8	40.0	48.1	48.2
	31	39	39	116*	25.8	22.9	21.5	24.6

*** Note: Throughout these tables, the adults of unknown birth date are included in the totals only.**

DOE:	NUMBER OF PERSONS 1	2	3	Total	% OF PERSONS IN EACH CATEGORY 1	2	3	Total
5. Other Symptoms of Poor Health:								
15 and under	9	4	2	23	15.3	4.9	2.4	10.3
16 to 34	4	13	11	28	30.8	27.1	21.6	25.0
35 and over	20	5	9	34	55.6	25.0	33.3	41.0
	39	27	27	101*	32.5	15.9	14.9	21.4
6. General Physical Abnormalities:								
15 and under	4	6	5	18	6.8	7.4	6.0	8.0
16 to 34	--	--	2	2	--	--	3.9	1.8
35 and over	4	--	--	4	11.1	--	--	4.8
	9	9	8	29*	7.5	5.3	4.4	6.2
7. Heart:								
15 and under	3	11	3	20	5.1	13.6	3.6	8.9
16 to 34	1	3	2	6	7.7	6.3	3.9	5.4
35 and over	8	3	2	13	22.2	15.0	7.4	15.7
	13	18	9	43*	10.8	10.6	5.0	9.1
8. Mental and Neurological Abnormalities:								
15 and under	1	--	1	2	1.7	--	1.2	0.9
16 to 34	1	3	1	5	7.7	6.3	2.0	4.5
35 and over	1	--	1	2	2.8	--	3.7	2.4
	3	3	3	9*	2.5	1.8	1.7	1.9
9. Reproductive (women only):								
16 to 34	2	12	5	19	25.0	36.4	22.7	30.2
35 and over	14	6	6	26	66.7	60.0	46.2	59.1
	22	23	11	56*	62.9	41.1	25.6	41.8

1. Infectious diseases are more frequent in children and in the elderly, as would be expected. There is also a slight indication of higher rate with higher radiation exposure status (all ages):

DOE exposed	15.0% with infectious diseases
DOE controls	13.5% with infectious diseases
Not in DOE	9.4% with infectious diseases

*** Note: Throughout these tables, the adults of unknown birth date are included in the totals only.**

2. Tumours and cysts appear clearly related to direct high level radiation exposure and to parental radiation exposure for the 16 to 34 year old adult children of DOE Status 1 Rongelapese.

Those born before 1954:	25.0% of DOE exposed
	5.0% of DOE controls
Those born after 1954:	15.4% of those whose parents were DOE exposed
	4.2% of those whose parents were DOE controls

3. Thyroid related illnesses are clearly a direct high level radiation exposure related phenomenon, probably more widespread geographically than just to the Rongelap atoll. It may also be age related.

Those born before 1954, (regardless of atoll of residence):	32.5% with thyroid problems
Those born after 1954 (regardless of atoll of residence):	8.9% with thyroid problems

4. Serious Medical problems are age related and also probably radiation exposure status related.

DOE Exposed:	25.8% with serious medical problems
DOE Controls:	22.9% with serious medical problems
Not in DOE:	21.5% with serious medical problems

5. Other symptoms appear to be both radiation related and age-related. This is true for not only those born before 1954, but also for the young adults and for the children. Since radioactive chemicals absorbed into the body randomly damage cells, non-specific illnesses are to be expected. In addition to cataracts, leukemia and cancer the list of suspected radiation related illnesses would include:

Altered susceptibility to infection (cell mediated immunity);

Histologically inapparent chromosomal and cytogenetic damage;

Cytogenetic changes in circulating blood lymphocytes;

Infertility;

Defects in offspring, often mild;

Age-related tissue changes especially affecting muscles and nerves; joints, cardiovascular system and supportive connective tissues, occur at a younger than expected age.

This list is based on studies of Atomic veterans (personal communication from Dr. Donnell Boardman).

6. General physical abnormalities are highest in the children and show a slight radiation relation. This may be due to genetic damage, expressed in the second generation offspring.

7. Heart problems are age related but also appear higher in DOE status 1 and 2. The high proportion of children with this type of medical problem requires further clarification. The DOE exposed and control adults born before 1954 have surprisingly high rates of heart disease. This may be related to inhalation of alpha particles which are absorbed into blood, damaging blood vessels. Animal experiments have confirmed the formation of benign tumours in blood vessels exposed to alpha particles. (See also J. Borak, M.D. "Radiation Effects on Blood Vessels", Radiology, Vol. 38, 481-492, 607-617 and 718-727.)

8. Mental and neurological abnormalities appear most frequent in the first generation offspring of the DOE exposed and control groups. This may be the consequence of in utero exposure to residual fall-out. It might be important to examine suicides and attempted suicides in the 16 to 34 year group with this neurological damage in mind. Psychological and sociological disruption of family and community may also have contributed to these problems.

There is one more disease of serious concern in the Marshall Islands which needs to be mentioned separately, namely diabetes. The distribution of cases cannot be attributed solely to the introduction of a Western diet. Incidence rates are as follows:

DOE exposed: 11.5% (7/61)
DOE controls: 7.9% (7/89)
Not in DOE: 5.2% (5/97)

The type of diabetes and probable etiology needs to be investigated by a specialist in this disease. It probably is multifactorial: inheritance, viral insult, autoimmune mechanisms, nutrition and obesity. A broader study of the Marshallese is needed.

It is extremely unlikely that the consistent patterns of health problems related to DOE status are occurring by chance. There are also health problems clearly related to parental DOE status, and health problems which appear related to living on the contaminated Rongelap atoll.

We would suggest initiating a maternal child health program and medical care program to understand and compensate for the negative health trends observed in the Rongelap population. This will require further medical consultation with the Rongelap people and with medical specialists in a variety of disease categories.

INTRODUCTION TO PARTS III AND IV

Over the years the Brookhaven National Laboratory (BNL) has conducted various medical tests on the Rongelap people in the DOE Status 1 (exposed) and DOE Status 2 (control) group. Some, but not all, of this information was published by BNL in various summary booklets, and some was released for evaluation in connection with the 1988 Kohn Phase I Study.

Crucial data not released by BNL (to April 1989) include:

1. Blood analyses for the DOE Status 1 (exposed) population and their children;

2. Blood analyses for the children of the DOE Status 2 control population;

3. The blood chromosome tests done, apparently, on several of the exposed and control Rongelapese.

It is important that this information be examined so that a reasonable follow-up can be designed.

Part III is the data on the DOE control population blood parameters as presented to Congress in April, 1988. Part IV is a look at the DOE control population relative to an expected (or normal) population. Other populations exposed to radioactive chemicals in particulate form, for which monocyte counts are available, are also included. They indicate that monocytopenia (depressed monocyte counts) may be characteristic of this type of exposure. This is an original finding of IICPH and will be reported in professional literature. Further research is now in progress to clarify the immune mechanism. It is, however, well known that monocytes are phagocytic cells which attempt to rid the body of particulates such as radioactive chemicals.

PART III

REPORT ON BNL BLOOD TESTS
RONGELAP CONTROL POPULATION

Blood test averages are given for those persons who were tested on the indicated Island or Atoll in each of the five years of the time period. Age information was not given for each person, therefore in this first report we did not control for age. Only the white blood count and differential is reported here.

Where the residence is marked "unknown", the persons were recorded on more than one Island or Atoll during the five year period.

The average Monocyte count on all three Atoll or Island Communities was below the clinically significant value (200 M per cubic millimetre of blood) in 1957 - 1961, probably indicating severe bone marrow depression. Bone marrow is known to be highly sensitive to radiation. Rongelap children had a slightly elevated average weight in pounds. Rongelap children eosinophil count was elevated, which may indicate either parasites or trauma. Since these are the BNL controls, this evidence appears to indicate that the Bravo event affected all of the Rongelap community, not just those on Rongelap Atoll 1 March 1954. It also raises serious question about the suitability of this population to serve as a control population for the Brookhaven studies of the high exposure Rongelapese.

There is evidence of monocyte recovery in the 1962 - 1966 period, although the average is still low. On Rongelap, the average monocyte count for these controls was 202 M per cubic millimetre of blood, which indicates that many of the controls were still experiencing depressed monocyte counts. The eosinophil averages were still quite high, especially in Ebeye, probably reflecting the living situation there which was overcrowded.

During the 1982 - 1986 period, monocyte counts appear stabilized on the three Atolls or Islands. With the apparent recovery toward normal monocyte counts in 1982-1986, it is not possible to dismiss reduction in fallout particle body burden as an important factor. This theory appears to hold for communities other than Rongelap which were exposed to radioactive particulates. As of the 1982-1986 period, there appears to be no reason to expect normal healthy persons to have adverse white blood effects attributable to residence on Rongelap. This, of course, assumes the same availability of imported uncontaminated food as was the case in 1982 - 1986.

Now that the Brookhaven control data is available on computer, further analysis can be undertaken. This will be included in the final report to Congress.

The generally depressed monocyte count of the Rongelap People regardless of whether or not they were on the Rongelap Atoll at the time of the Bravo event should have been noted and reported by BNL at the time.

This report strongly indicates that contamination was widespread and all of the Islands may have received fallout. Further investigation of this is indicated.

It is also important that BNL data on Rongelap exposed persons be released for analysis.

REPORT ON RONGELAP CONTROLS USED BY BNL

LYMPHOCYTE COUNTS*

Years	Number	Island or Atoll**	Mean + Std. Error
1957-61	145	Rongelap	3665 ± 96
	2	Majuro	2820 ± 140
	1	Ebeye	1600
	75	Unknown	3523 ± 164
1962-66	158	Rongelap	3200 ± 210
	23	Majuro	2657 ± 262
	85	Ebeye	3208 ± 135
	22	Unknown	3288 ± 203
1982-86	70	Rongelap	2828 ± 99
	61	Majuro	2812 ± 112
	141	Ebeye	2661 ± 66
	178	Unknown	2717 ± 75

* Clinical significance is below 1500 cells/cubic millimetre of blood

** Were tested on the same Atoll each of the five years; otherwise, "unknown".

REPORT ON RONGELAP CONTROLS USED BY BNL

NEUTROPHIL COUNTS*

Years	Number	Island or Atoll**	Mean + Std. Error
1957-61	145	Rongelap	4530 ± 143
	2	Majuro	4315 ± 875
	1	Ebeye	2500
	75	Unknown	3830 ± 159
1962-66	158	Rongelap	4208 ± 173
	23	Majuro	4339 ± 366
	85	Ebeye	4403 ± 197
	22	Unknown	3648 ± 309
1982-86	70	Rongelap	4200 ± 189
	61	Majuro	3942 ± 210
	141	Ebeye	4415 ± 140
	178	Unknown	3815 ± 100

* Clinical significance is below 2500 Neutrophils per cubic millimetre of blood.

** Were tested on the same Atoll each of the five years; otherwise, "unknown".

REPORT ON RONGELAP CONTROLS USED BY BNL

MONOCYTE COUNTS*

Years	Number	Island or Atoll**	Mean + Std. Error
1957-61	134	Rongelap	169 ± 13
	2	Majuro	120 ± 50
	1	Ebeye	100
	75	Unknown	104 ± 10
1962-66	158	Rongelap	203 ± 11
	23	Majuro	261 ± 32
	85	Ebeye	250 ± 21
	22	Unknown	231 ± 39
1982-86	69	Rongelap	329 ± 26
	61	Majuro	320 ± 20
	138	Ebeye	305 ± 15
	172	Unknown	305 ± 13

* Clinical significance is below 200 monocytes per cubic millimetre of blood.

** Were tested on the same Atoll each of the five years; otherwise, "unknown".

PART IV

As was noted in my April 1988 report, the monocyte counts of the Rongelap people were quite abnormal. Monocytes are a type of white blood cell which acts as a scavenger. They migrate out of the blood stream into tissue and engulf foreign materials such as particles of uranium or plutonium. Depression in monocyte counts appears to be associated with exposure to bone-seeking radioactive particulates.

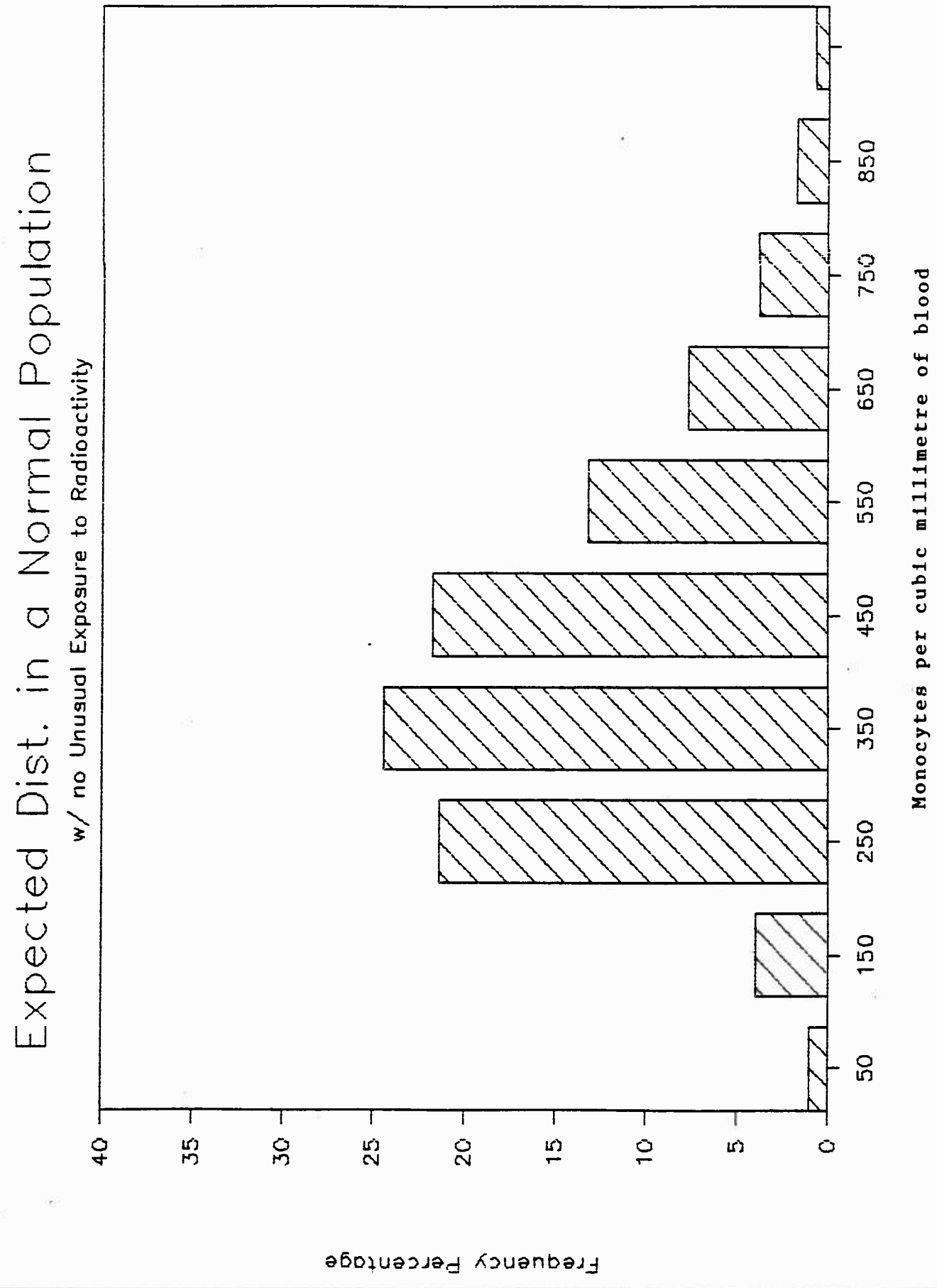
Monocyte counts do not differ in different races. Their number is normally 200 to 800 per cubic millimetre of blood. The expected distribution of monocytes in a normal population is given in the first bar graph (Graph A) so that the reader can easily compare the Rongelap population with a normal population. In a normal population about 5% would be expected to have monocyte counts below 200 M per cubic millimetre of blood. The International Institute of Concern for Public Health has observed an abnormally large proportion of the population with depressed monocyte counts in studies in Malaysia and Canada. The biological mechanism may include both radiation damage to bone marrow and destruction of monocytes attempting to remove particulate radioactive chemicals from the body.

When the monocyte count increases above 800 M per cubic millimetre it may indicate a beginning of a proliferative growth of monocytes, which can lead to a leukemia. Follow-up of these persons would be important. Monocytes are formed in bone marrow and are sensitive to radionuclides which accumulate or are stored in bone. Thus, both an abnormal decrease in monocytes and an abnormal increase in monocytes can be indicative of exposure to radioactive particulates.

Graphs B and C show the monocyte counts of the DOE control adults. The first graph is the distribution of monocyte counts between 1957 and 1961 when they were living on the contaminated Rongelap Atoll. Graph C is the distribution of monocyte counts taken for the same group of adults in 1982 to 1986. While still abnormal, these later counts show considerable recovery toward a normal distribution (Graph A).

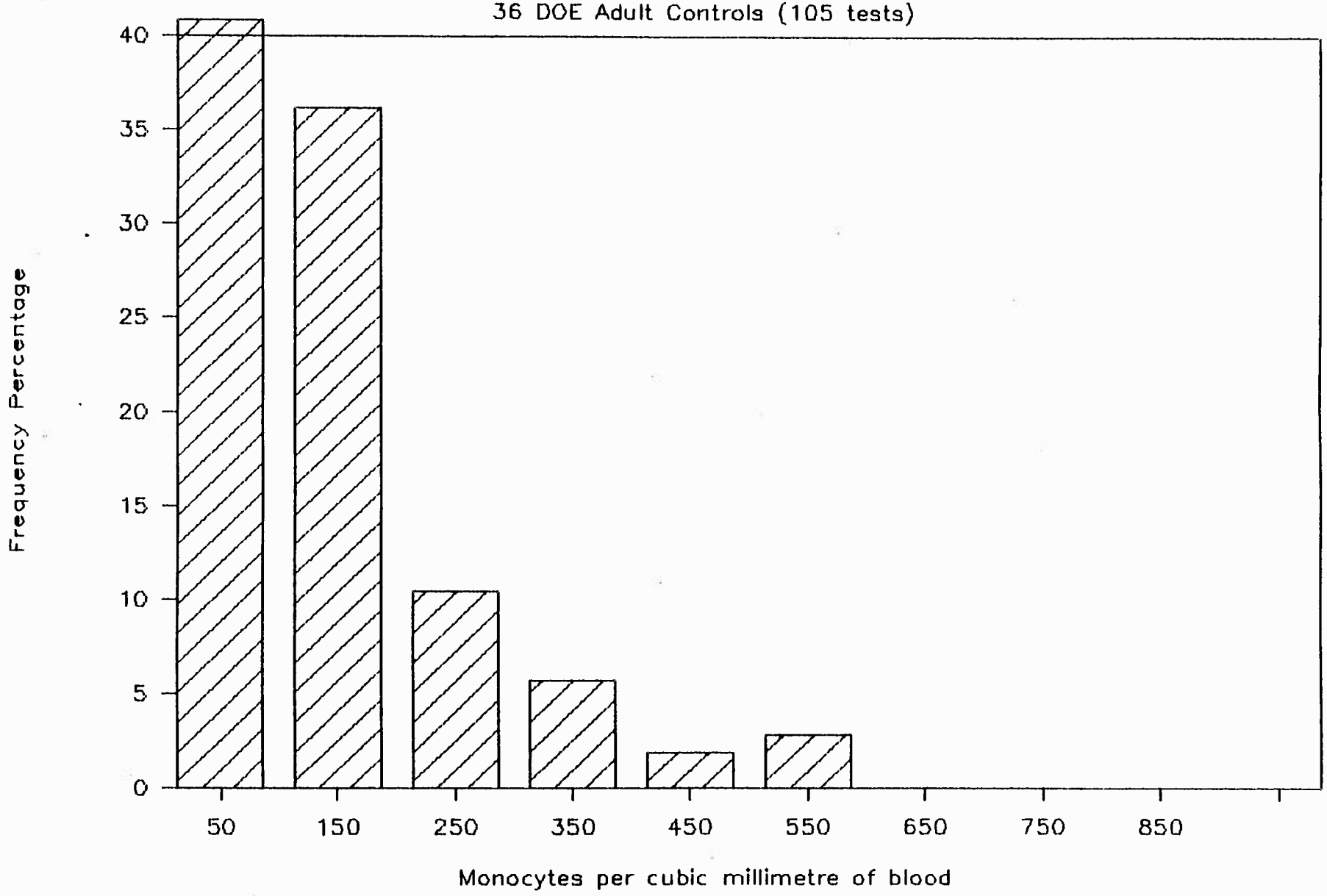
In the 1982-1986 graph one finds a beginning of abnormal monocyte proliferation among the controls. This may lead to some cases of leukemia in this population.

Graph A


Expected Dist. in a Normal Population
w/ no Unusual Exposure to Radioactivity
Frequency Percentage
0
5
10
15
20
25
30
35
40
50
150
250
350
450
550
650
750
850
Monocytes per cubic millimetre of blood

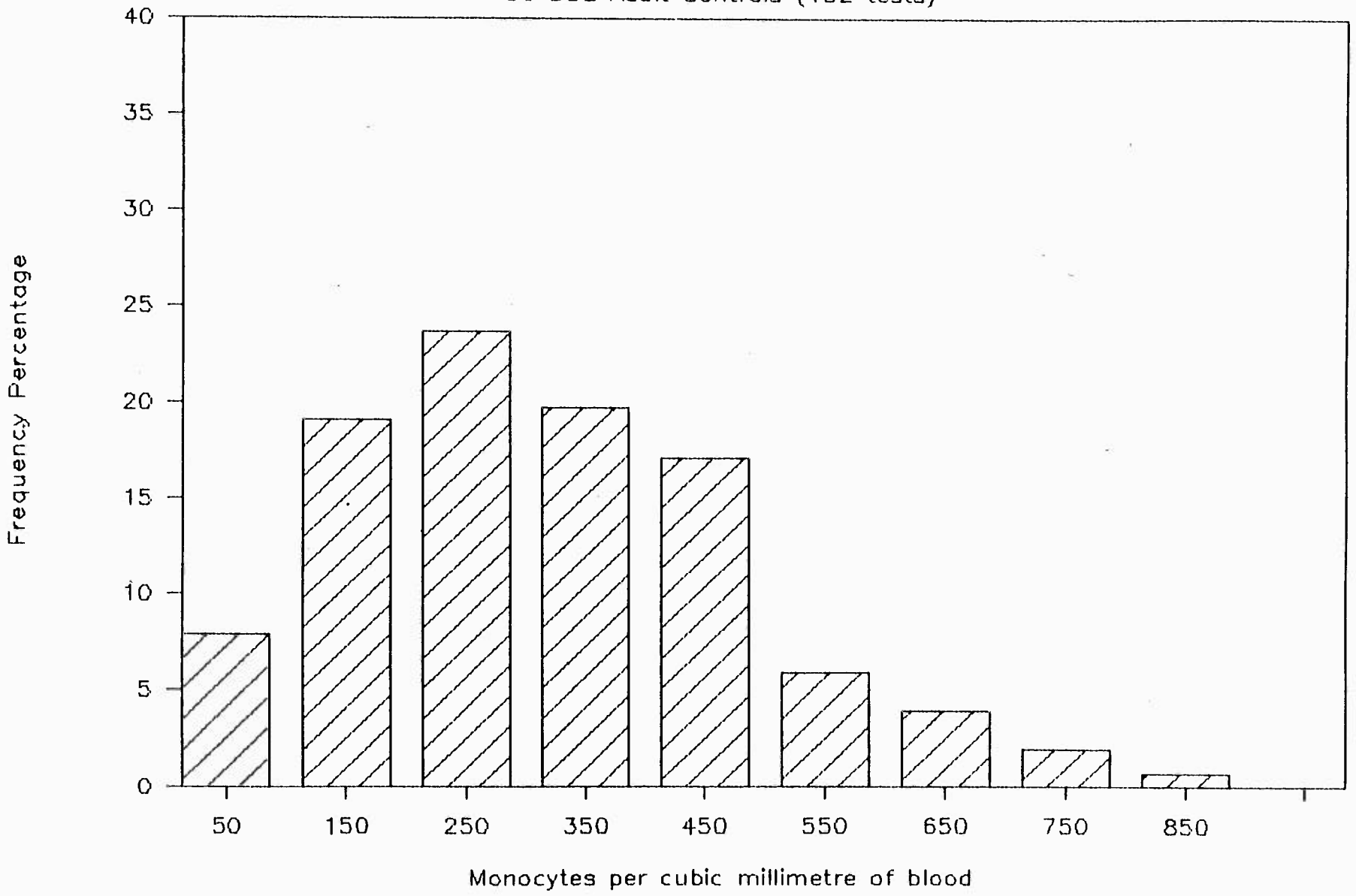
Marshall Islands – 1957–61 Measurements

36 DOE Adult Controls (105 tests)



Marshall Islands – 1982–86 Measurements

36 DOE Adult Controls (152 tests)



43
Graph C

Graph D is the distribution of monocyte counts for adults used by Brookhaven as controls in 1982-86, for whom we have no records in 1957-61. Brookhaven has admitted adding to their control population over the years. Of the 79 adults tested in 1982-86, 21 were "new", i.e. had no records in 1957-61.

Graphs E through G are other adults exposed to radioactive particulates. Their monocyte counts were measured and graphs of the distribution, similar to that of the DOE controls, were made.

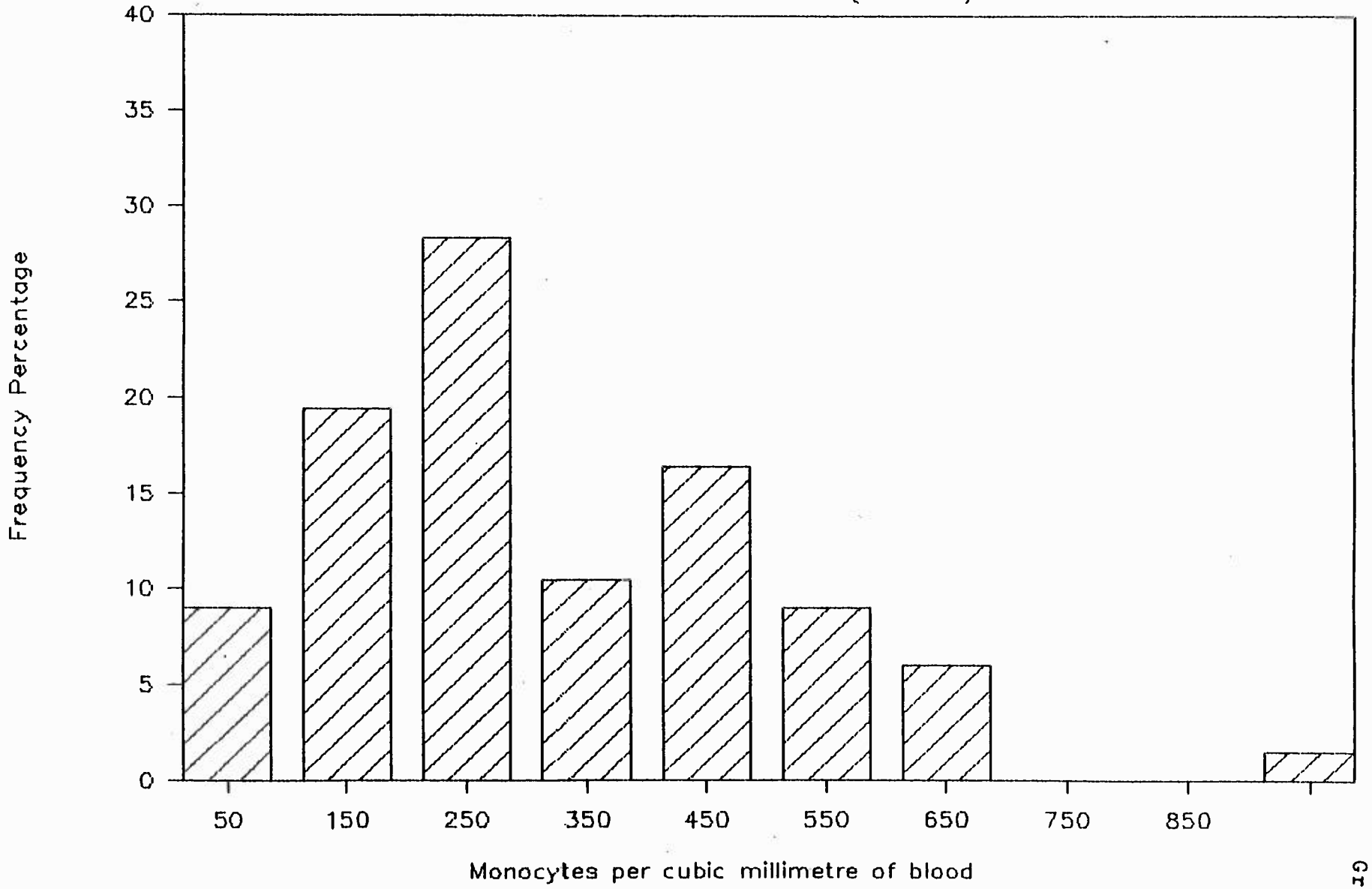
> Graph E: shows the distribution of monocyte counts for 43 Asian Rare Earth employees in Malaysia. They were handling radioactive thorium hydroxide waste. Note the large proportion with monocyte counts below 200 M/mm^3 and the increased number above 800 M/mm^3 (personal communication).
>
> Graphs F and G: show the distribution of monocyte counts for adults with exposure to radium and uranium debris buried in a residential area outside Toronto, Canada. The adults exposed to buried debris in their back yards are represented by Graph F. Their relatively uncontaminated neighbours are represented on Graph G.

We have no record of selection criteria used by DOE with respect to blood samples. The blood samples used for graphs E through G were from persons with no fever or known infection.

The general pattern observed here is an increase in the proportion of the population with depressed monocyte count with increased exposure to radioactive particulates.

Marshall Islands – 1982–86 Measurements

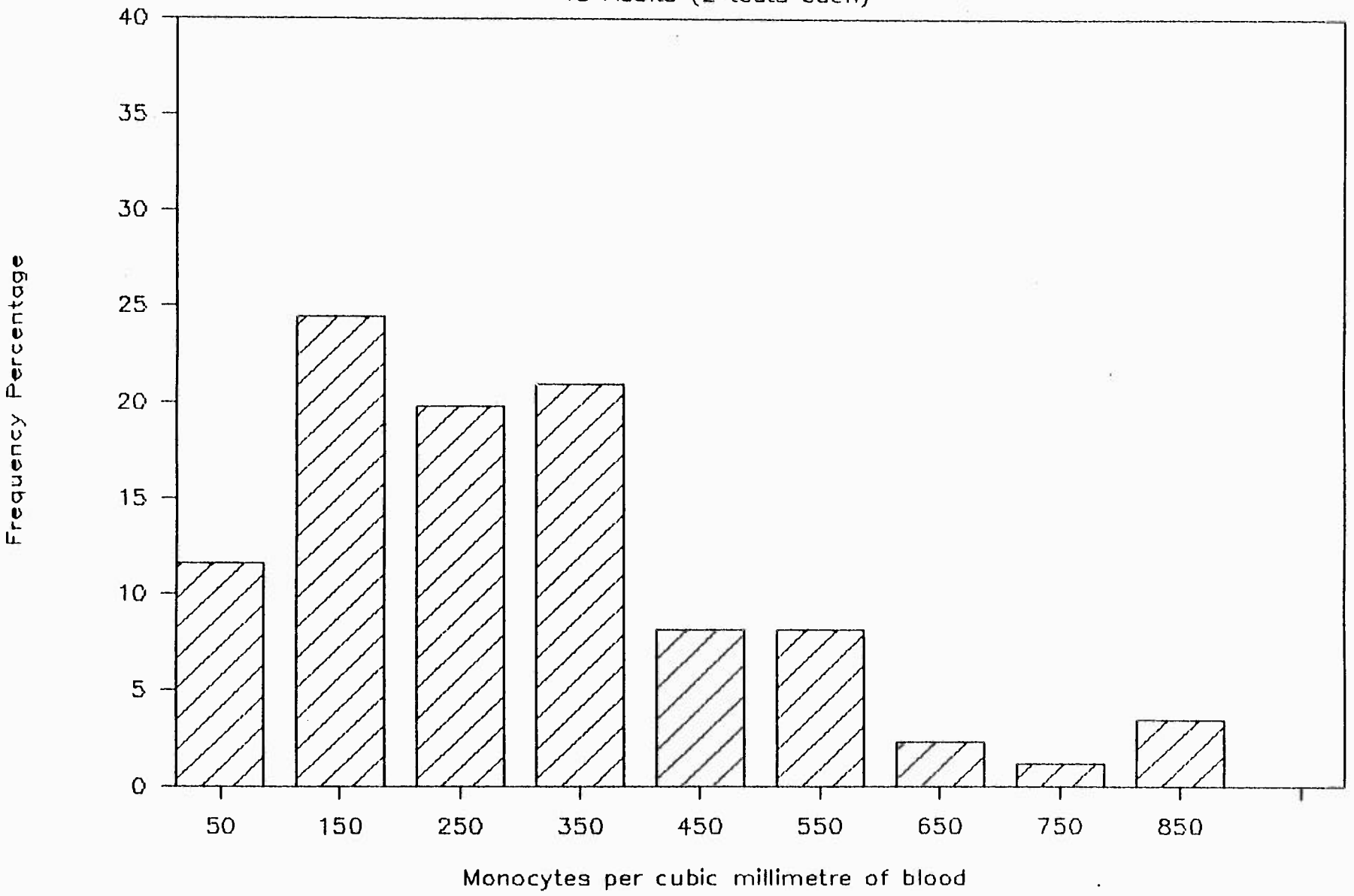
21 Brookhaven Adult Controls (67 tests)



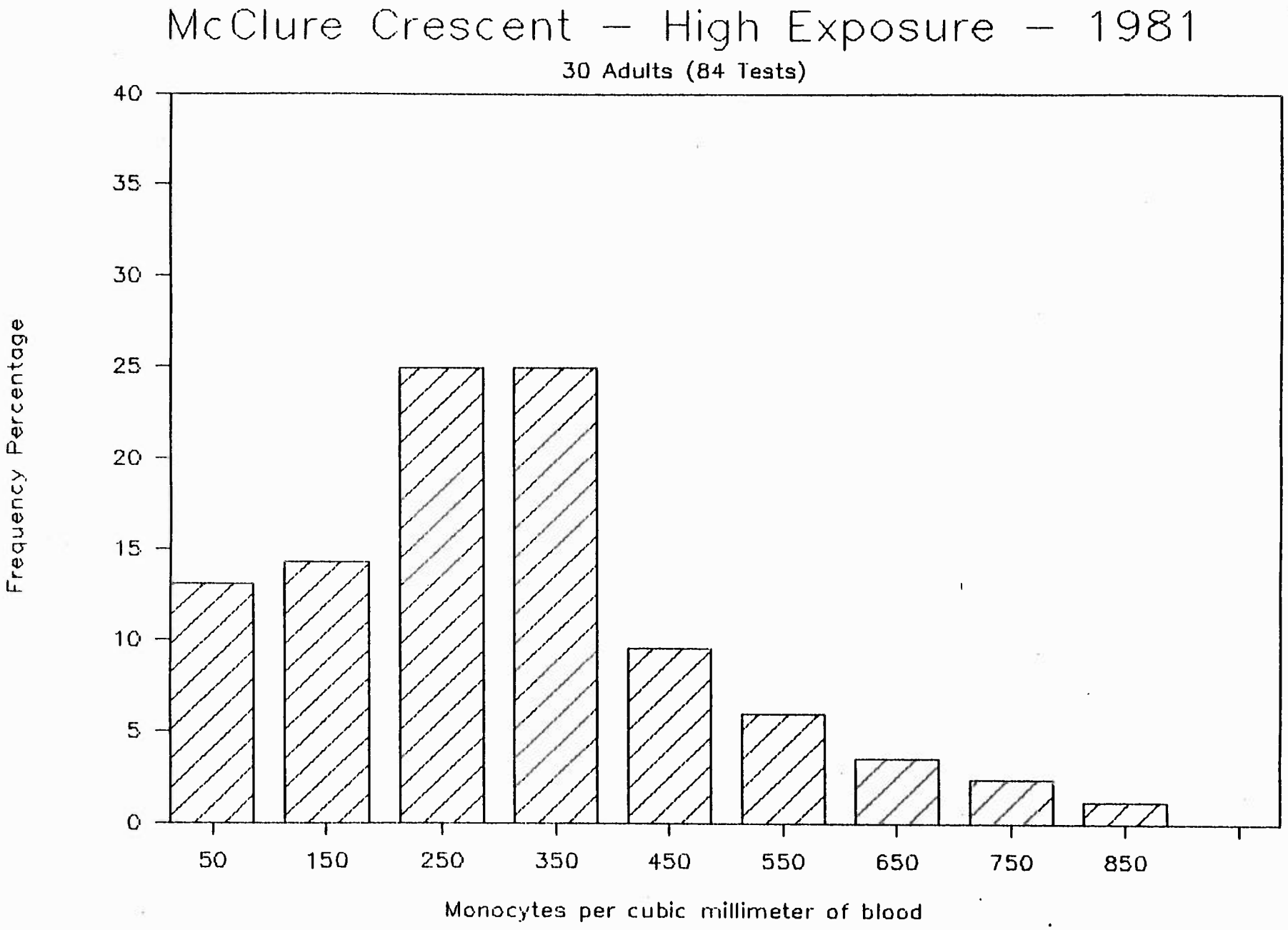
45
Graph D

Rare Earth Workers – 1986–87

43 Adults (2 tests each)



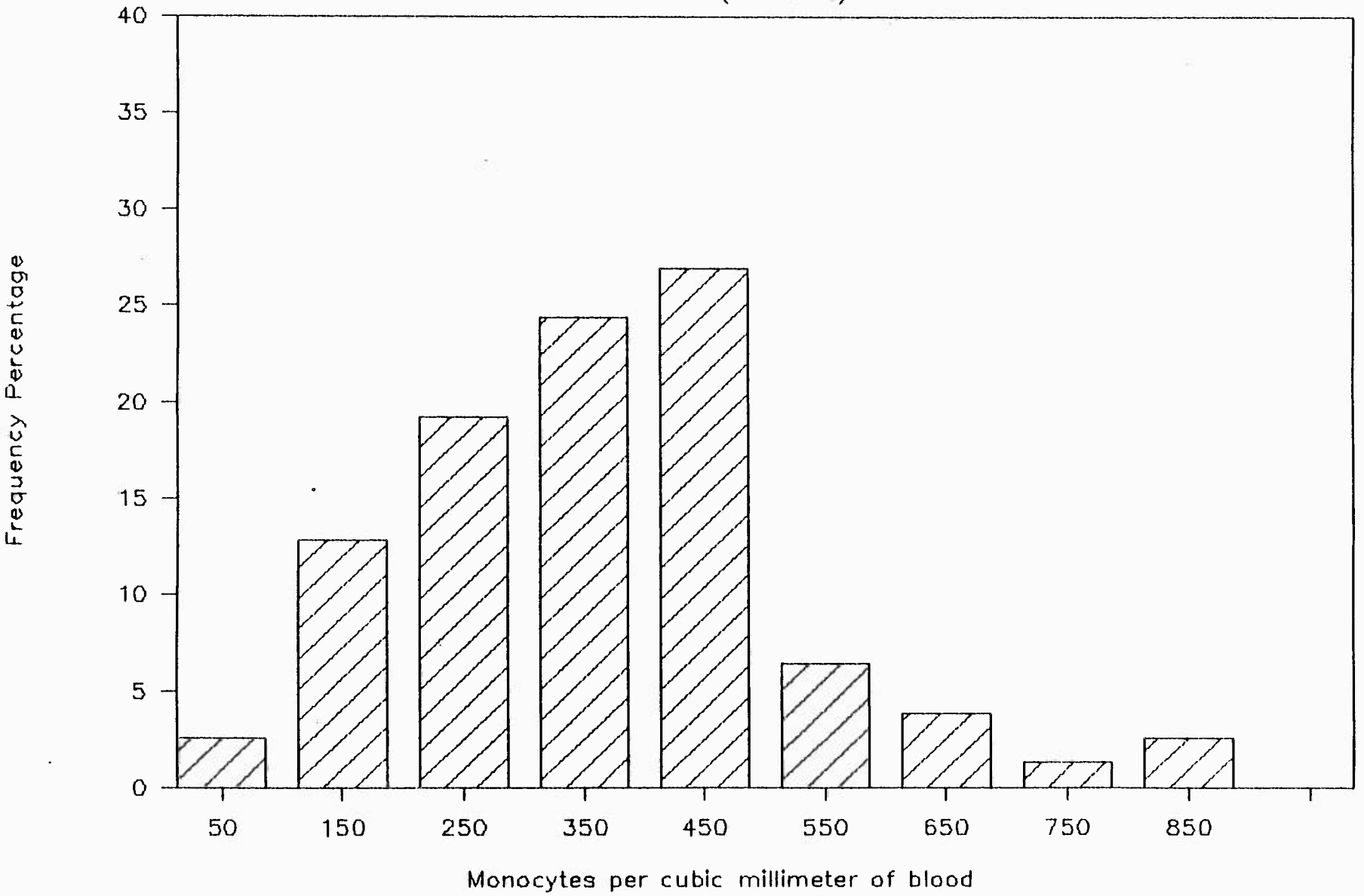
46
Graph E


McClure Crescent – High Exposure – 1981
30 Adults (84 Tests)
Frequency Percentage
40
35
30
25
20
15
10
5
0
50
150
250
350
450
550
650
750
850
Monocytes per cubic millimeter of blood

47
Graph F

McClure Crescent — Low & Med Exp — 1981

31 Adults (78 Tests)



48
Graph G

In Graphs H through M, the distribution of monocyte counts for children are given.

Graph H: Marshall Island children living on Rongelap Atoll between 1957 and 1961. These monocyte counts are very abnormal and probably reflect the exposure to residual radiation on the Atoll.

Graph I: shows the distribution of monocyte counts for the same Rongelapese in 1982-1986. They are now adults. Some are still abnormally low, while a few are in the over 800 M/mm^3 range. Follow-up is important for these adults.

Graphs J and K: show the distribution of monocytes for the 24 children with low residential exposure to radium-uranium debris and 34 children with exposure to debris buried in their back yards. Each child had about three blood tests.

Graph L: shows the monocyte count distribution of sixty Malaysian children exposed to the Asian Rare Earth Company's thorium hydroxide waste for 4 months in 1987.

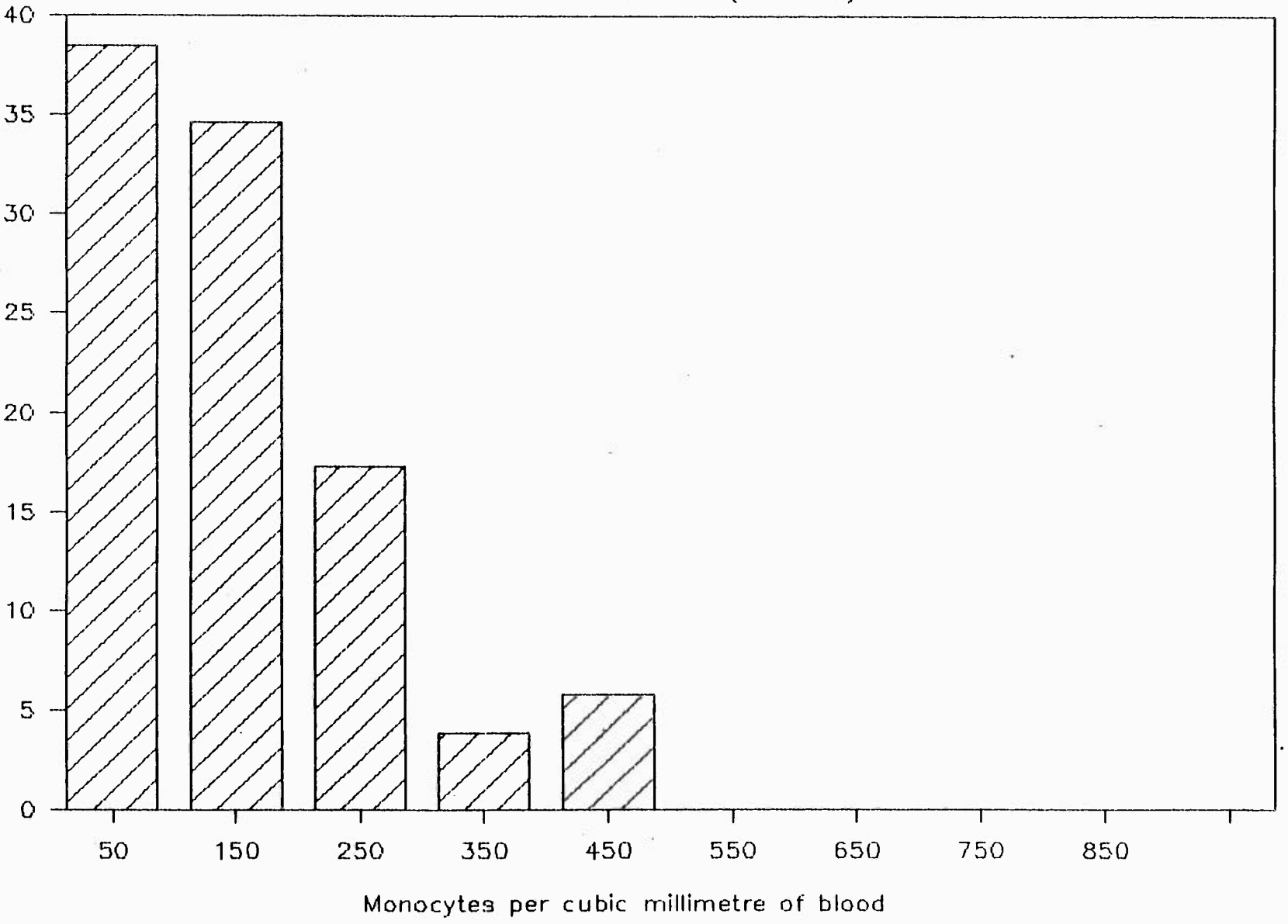
Graph M: shows the 1988 monocyte count distribution of forty-four Malaysian children exposed to the Asian Rare Earth Company's thorium hyudroxide waste for 16 months.

The Malaysian community from which these children were drawn experienced three childhood leukemia cases in 1989 where only one case every 30 years was expected.

It is important to provide yearly complete blood counts and differentials for the Rongelap people. The abnormality of the control population may indicate that the exposed group is even more severely affected. It is my judgment that persons with abnormal blood counts should not live on the contaminated atoll. They require assured rations of uncontaminated food and access to preventive medical care.

Marshall Islands – 1957–61 Measurements

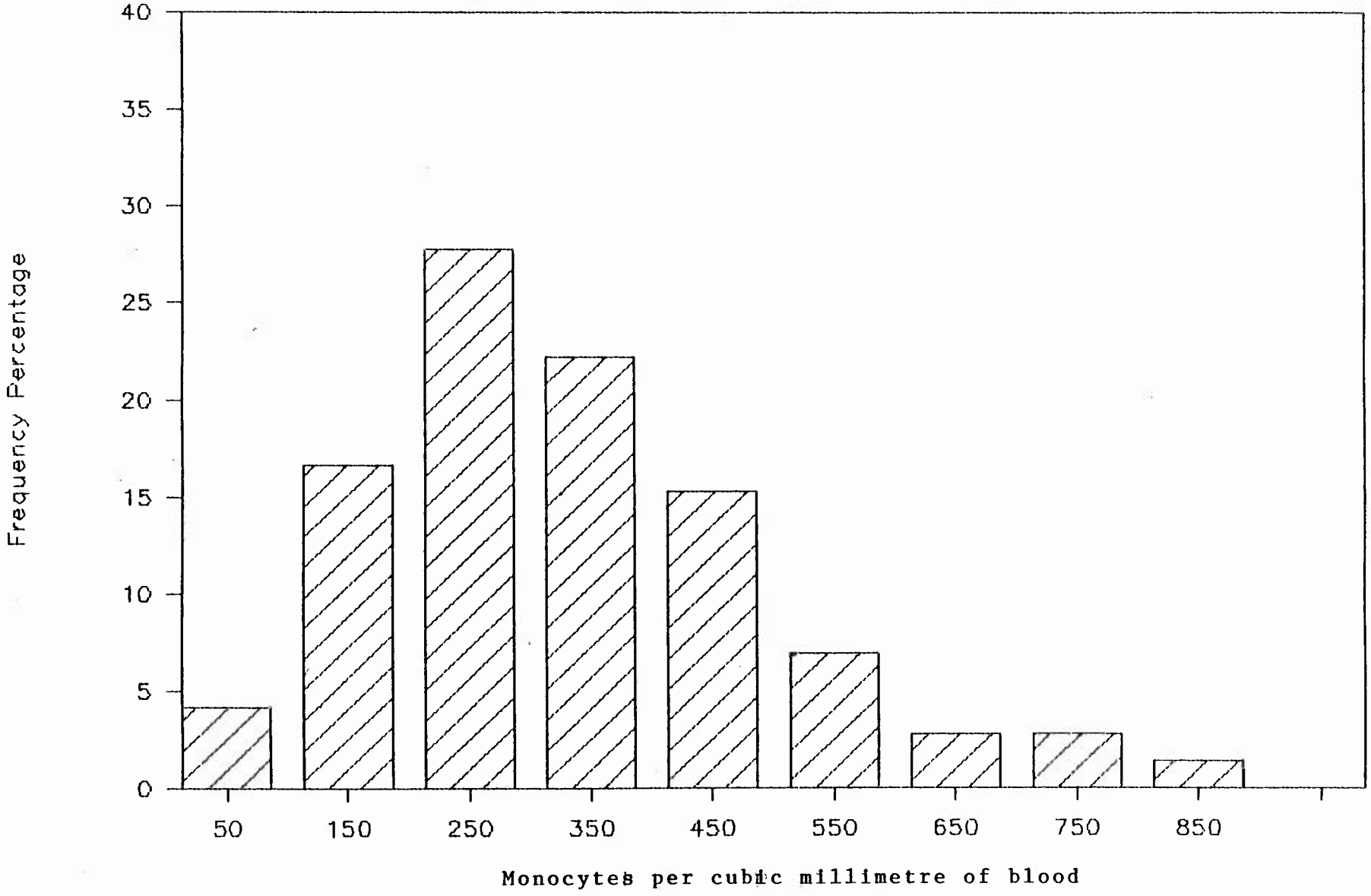
22 DOE Children Controls (52 tests)



50
Graph H

Marshall Islands – 1982–86 Measurements

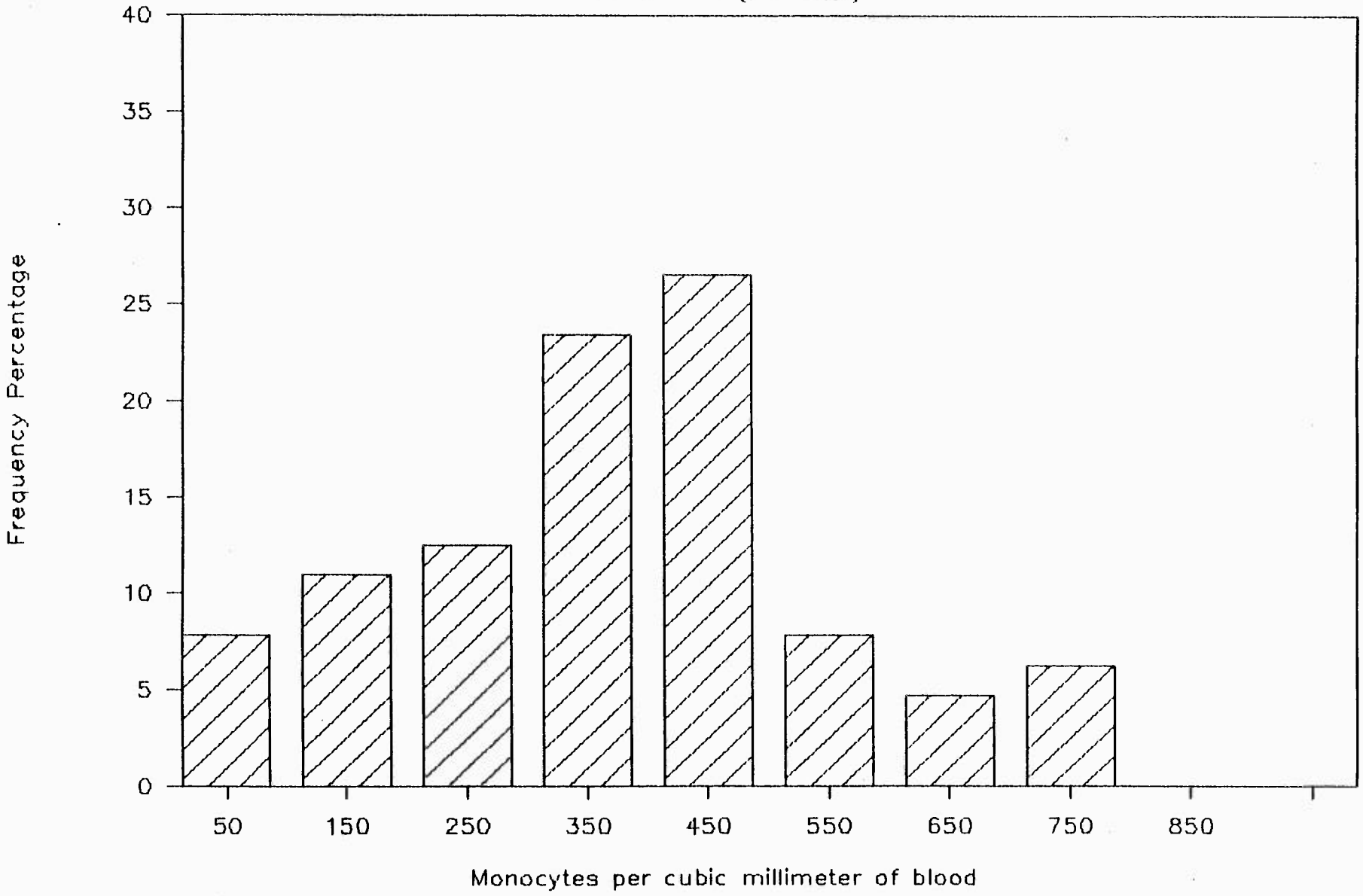
DOE Adult Controls tested as Children 1957–61



51
Graph I

McClure Crescent — Low & Med Exp — 1981

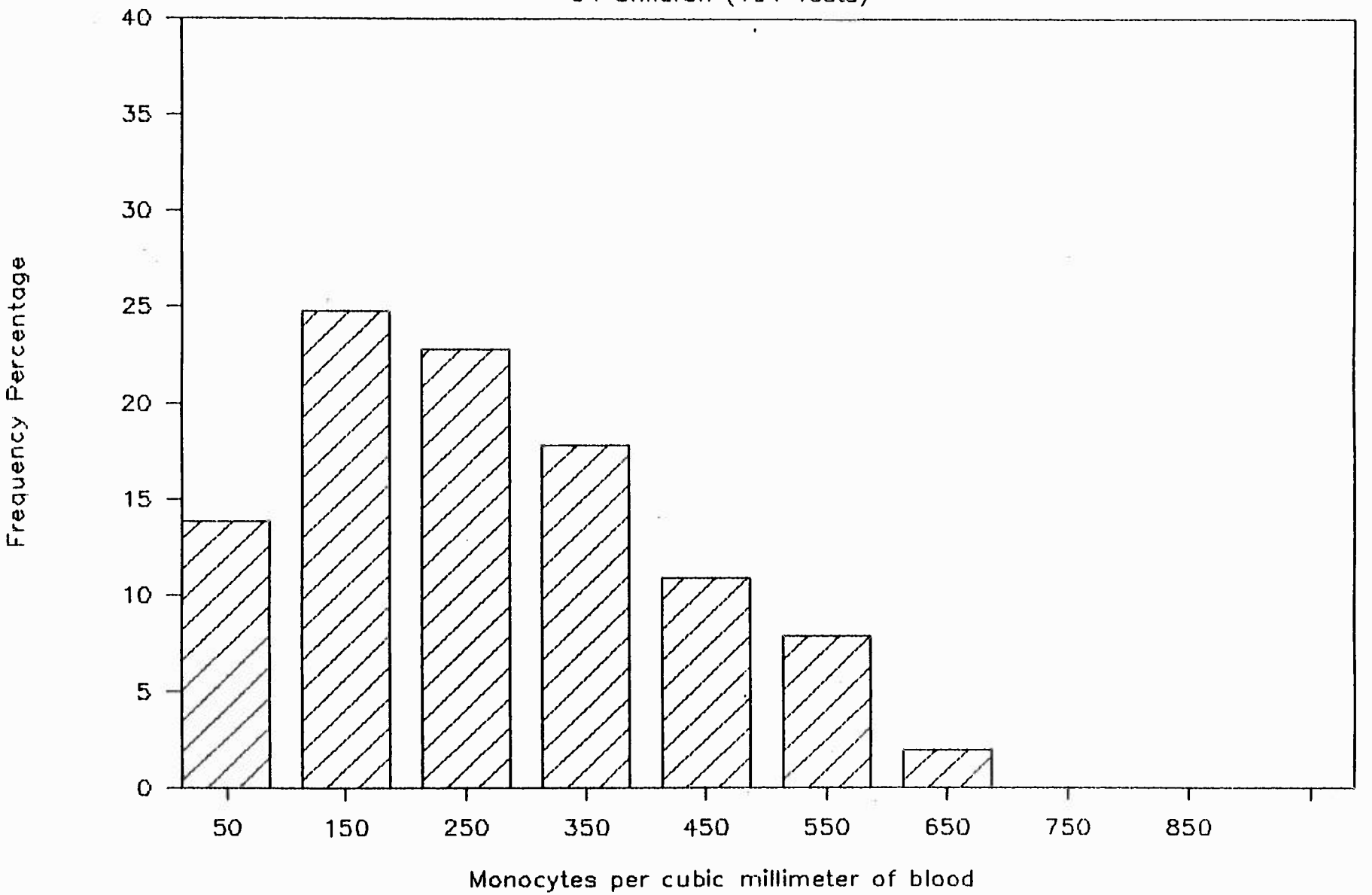
24 Children (64 tests)



52
Graph J

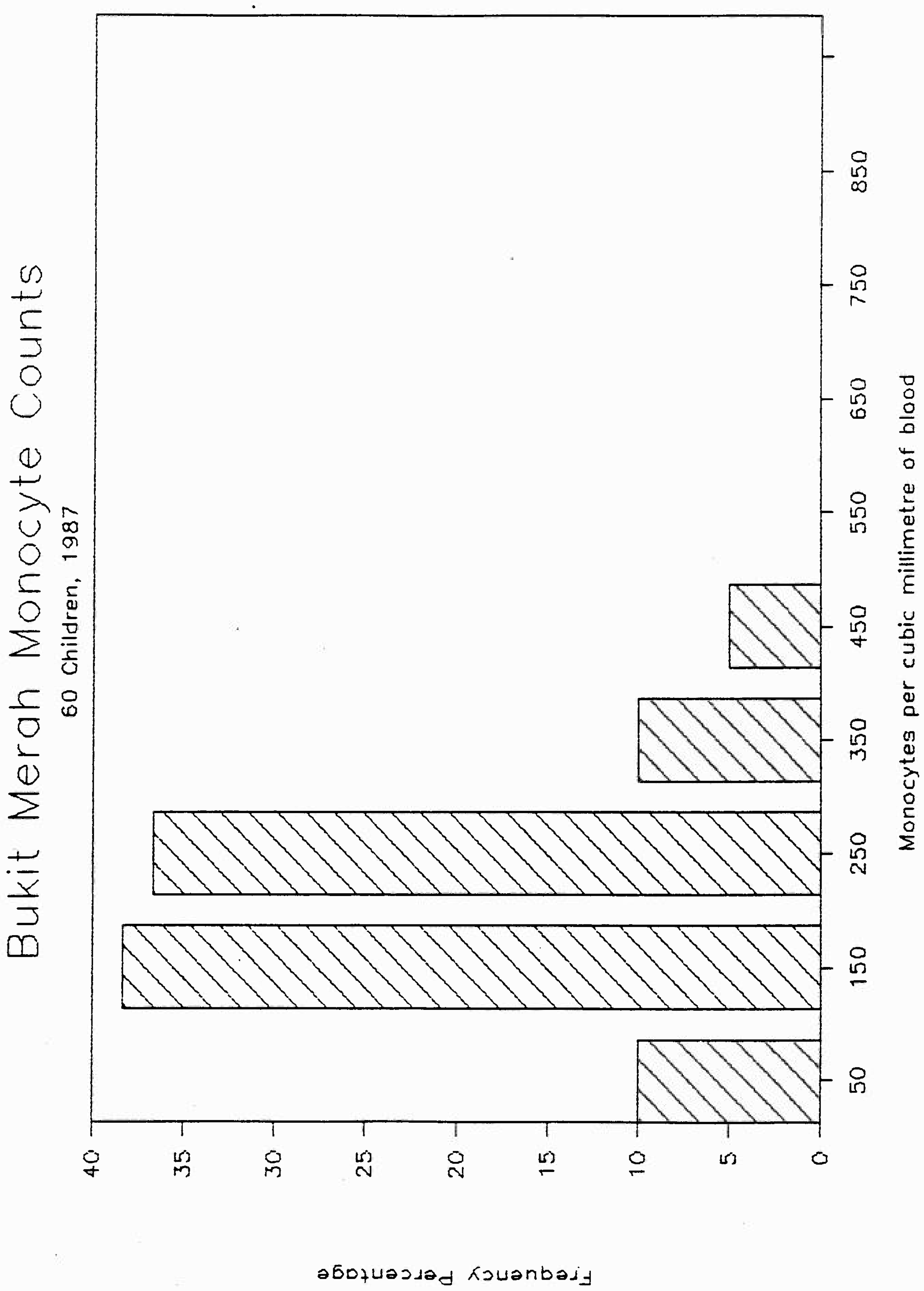
McClure Crescent — High Exposure — 1981

34 Children (101 Tests)



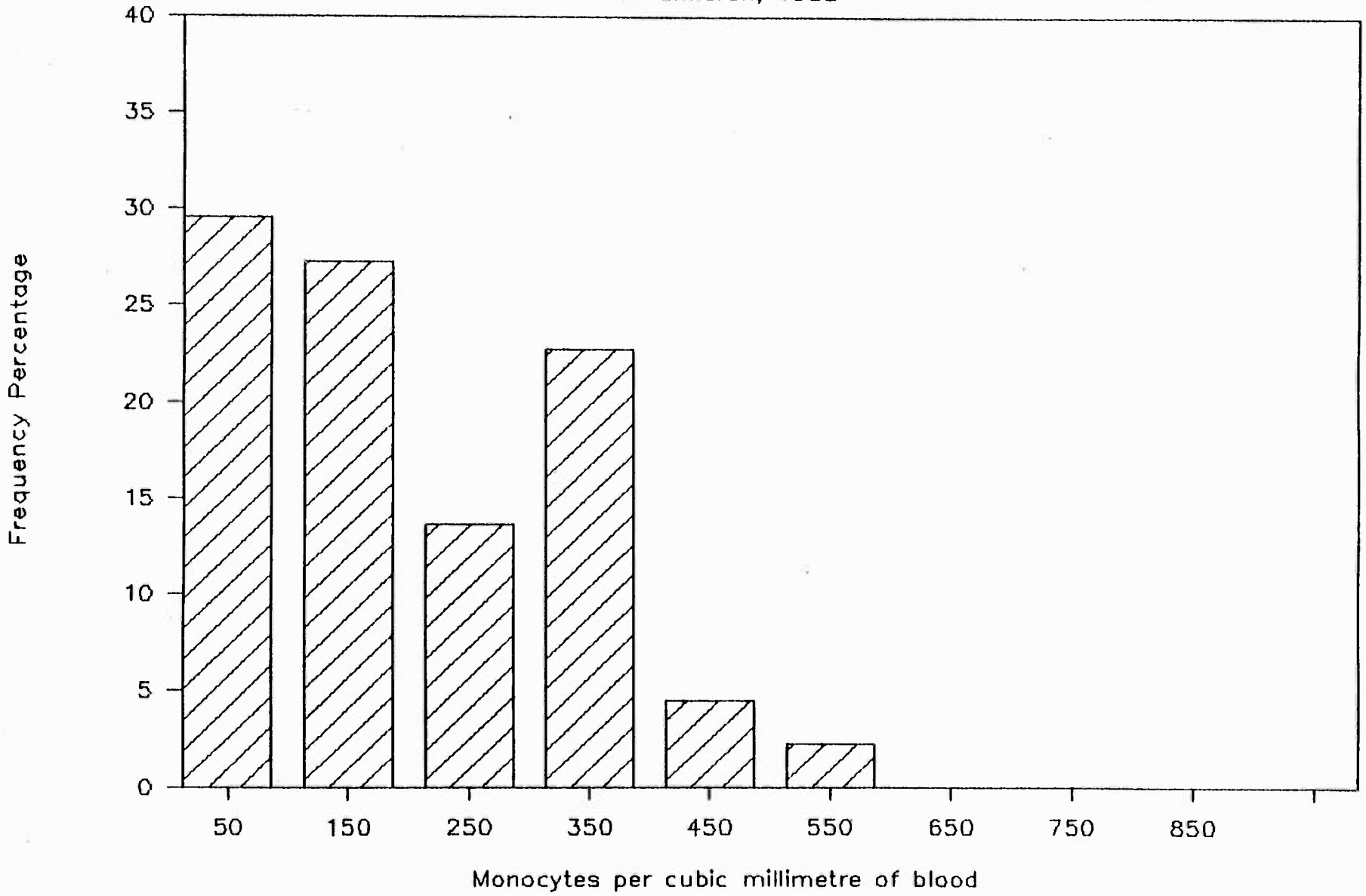
53
Graph K

Graph L


Bukit Merah Monocyte Counts
60 Children, 1987
Frequency Percentage
Monocytes per cubic millimetre of blood
0
5
10
15
20
25
30
35
40
50
150
250
350
450
550
650
750
850

Bukit Merah Monocyte Counts

44 Children, 1988



55
Graph M

CHILD FORM (Under 16 years)

Code No:_____

Name:_____

Sex:_____Date of Birth:_____

Place of Birth:

_____Island;_____Atoll

Father's Code No:_____

Mother's Code No:_____

Father's Name:_____

Date of Birth:_____

Father's Place of Birth:

_____Island;_____Atoll

1 March 1954 Father was on:

_____Island;_____Atoll

Father Participated in cleanup operations on:

___ Bikini: Date(s):_____

___ Enelvetak: Date(s):_____

Mother's Name:_____

Date of Birth:_____

Mother's Place of Birth:

_____Island;_____Atoll

1 March 1954 Mother was on:

_____Island;_____Atoll

This child was the _____live birth; the

_____pregnancy for his/her Mother.

During the pregnancy, the Mother lived on:

_____Island;_____Atoll

_____Island;_____Atoll

_____Island;_____Atoll

During the pregnancy the Mother ate:

___ Local food: ___Sometimes, ___Usually,___Always

___ Imported food: ___Sometimes, ____Usually, ____Always.

___ Don't know.

Information on Child:

Weight:_____

Height:_____

Chest circumference:_____

Wrist Circumference:_____

Thyroid disease history:

Has the child had any surgeries?

___ yes

___ no

If yes, describe:

_____Year_____

_____Year_____

Has the child ever been sent to the US (___ Hawaii or ___ Mainland) for medical care?

___ yes

___ no

If yes, do you know what they did?

_____

Was the child among those who moved from Rongelap to Mejato?

___ yes

___ no

If yes, did he or she experience any change in health after leaving Rongelap?

___ no

___ better

___ worse

Do you think the change was due to food shortage?

___ yes

___ no

___ don't know.

Explain:

Other clinical impressions or oral history:

Eyes/ears/nose/throat:

Gastro-intestinal/rectal:

Cardio-vascular/renal:

Bronchial/Pulmonary:

Skin:

Alertness/Acuity:

Gonads:

Muscles:

Bones/Joints:

Endocrine Glands:

Other:

ADULT FEMALE:

Code No:_____

Name:_____

Date of Birth:_____

Place of Birth:

_____ Island; _____Atoll

Other places of residence:

_____Island; _____Atoll
19____ to 19 ____

_____Island; _____Atoll
19____ to 19_____

_____Island; _____Atoll
19____ to 19____

Are you a participant in the Department of Energy study?

___ yes

___ no

If yes, as:

___ an exposed person

___ a control person

Have you ever been sent to the U.S. for medical care?

___ yes

___ no

If yes, when: _____

Do you know what was done:

_____

Have you ever wished to become pregnant but been unable?

___ yes

___ no

Time period:_____

Do you know the cause:

_____

Pregnancies:

Order	Year	Outcome	Name if live birth	If now dead give year of death and cause If alive give Code No.
1st				
2nd				
3rd				
4th				
5th				
6th				
7th				

Were you one of the person evacuated from Rongelap to Mejato?

___ yes

___ no

If yes, have you experienced any change(s) in health since the moving?

___ no

___ better

___ worse

Have you ever had surgery?

___ yes

___ no

If yes, describe:

_____ Date:_____

_____ Date:_____

_____ Date:_____

Have you ever had thyroid disease:

___ yes

___ no

___ don't know

If yes, describe:

_____ Date:_____

Have you ever had a tumor or cancer:

___ yes

___ no

___ don't know

If yes, describe:

_____ Date:_____

Urine sugar test:

___ positive

___ negative

Do you think the change was due to food shortage?

___ yes

___ no

___ don't know

Explain:

Clinical impressions or oral history:

Eyes/Ears/Nose/Throat:

Gastro-Intestinal/Rectal:

Bronchial/Pulmonary

Skin:

Alertness/Acuity:

Gynecological:

Muscles:

Joints/Bones:

Endocrine Glands:

Other:

ADULT MALE:

Code No:__ ____

Name:_____

Date of Birth:_____

Place of Birth:
_____ Island; _____Atoll

1 March 1954 located on:
_____ Island; _____Atoll

Other places of residence:
_____Island; _____Atoll
19____ to 19____

_____Island; _____Atoll
19____ to 19____

_____Island; _____Atoll
19____ to 19____

Are you a participant in the Department of Energy study?

___ yes

___ no;

if yes, as:

___ an exposed person - or -

___ a control person

Did you help with the clean up at; (give dates):

___ Bikini: _____

___ Enewetak:_____

Have you worked at; (give dates):

___ Kwajelein: _____

___ Radar station:_____

What is your usual type of work?

___ fishing

___ store clerk

___ professional

___ government

___ teacher

___ medical worker

___ mechanic or construction worker

___ taxi driver

___ other _____

Have you ever been sent to the US (Hawaii or
__ Mainland) for medical care?

___ yes

___ no

If yes, when _____.

Do you know what was done?

_____

Have you ever had surgery?

___ yes

___ no.

If yes, describe:

_____Date:_____

_____Date:_____

Have you ever had thyroid disease:

___ Yes

___ No

___ don't know

If yes, describe:

_____ Date: _____

Have you ever had a tumor or cancer:

___ Yes

___ No

___ don't know

If yes, describe:

_____ Date: _____

Urine sugar test:

___ positive

___ negative

Did you ever wish to have children but were unable?

___ yes

___ no

If yes, when _____

Do you know the reason?

_____

Living children:

	Name	Year of Birth	Code no.
1.			
2.			
3.			
4.			
5.			
6.			

Were you one of the person evacuated from Rongelap to Mejato?

___ yes

___ no

If yes, have you experienced any change in health since leaving Rongelap?

___ no

___ better

___ worse.

Do you think the change was due to food shortage?

___ yes

___ no

___ don't know

Explain:

Clinical impressions or oral history:

Eyes/Ears/Nose/ Throat:

Gastro-intestinal/Rectal:

Cardio-vascular/Renal

Bronchial/Pulmonary:

Skin:

Alertness/Acuity:

Gonads:

Muscles:

Joints/Bones:

Endocrine Glands:

Other:

	Etiology	Diseases
1	CONGENITAL	AUTISM
		BIRTH DEFECT
		DOWN'S MOSAIC
		DOWN'S SYNDROME
		ESOTROPIA
		FACIAL ASSYMETRY
		HEART MURMUR
		HEMANGIOMA
		HIP DYSPLASIA
		HYDROCEPHALUS
		INGUINAL HERNIA
		KYPHOSIS
		LOSS OF NASAL BRIDGE
		ORGANOMEGALY
		PECTUS CARINATUM
		PECTUS EXCAVATUS
		PHYSICAL DEFORMITY
		SPINA BIFIDA
		TURNER'S SYNDROME
		UMBILICAL HERNIA
2	MAYBE EITHER CONG. OR ACQUIRED	ASTHMA
		BOW LEGS
		CHILD DIED WITHIN 1 YEAR OF BIRTH--CONGE
		DEV. DELAY (POSSIBLY MENINGITIS-RELATED)
		DIABETES
		GLUCOSURIA
		HEARING PROB.
		HYPOGLYCEMIA
		INFERTILITY
		MENTALLY HANDICAPPED/LEARNING PROB.
		OESOPHAGAL SPASM
		OTHER
		PHYSICAL PROBLEM/LIMP/PARAPALEGIC
		POSSIBLE EPILEPSY
		PROTEINURIA
		REFLUX ESOPHAGITIS
		SMALL FOR AGE
		STROKE
		SVR. MED. PROB.
		THYROID RELATED
		UNDIAGNOSED CNS PATHOLOGY
		VITILIGO
3	ACQUIRED	ABDOMINAL PAIN
		ACNE
		AMEBIC DYSENTRY
		AMPUTATION
		ANEMIA / MUSCOSAL PALLOR
		ANKYLOSING SPONDYLITIS
		ARTHRITIS/CERVICAL/ARTHRALGIA/KNEES
		ASCARIS
		BACKACHE
		BIOPSY/THYROID/ABD/BREAST/NECK

Etiology	Diseases
	BODY ACHES/PAIN/FACIAL/BURSITIS/FEET/KNE
	BRADYCARDIA
	BRONCHITIS
	CAESARIAN SECTION
	CANCER/TONGUE/STOMACH/BREAST
	CERVICAL DYSPLASIA
	CERVICAL NODE ENLARGEMENT
	CHEST ABCESS
	CHICKEN POX
	CHILD DIED WITHIN 1 YEAR OF BIRTH--INFEC
	CHOLECYSTECTOMY
	CHRONIC COUGH
	CONJUNCTIVITIS
	CORONARY ARTERY DISEASE WITH ANGINA
	DENTAL CARIES
	DEPRESSION/EMOTIONAL PROB.
	DIARRHEA
	DIZZY SPELLS
	ECTOPIC PREGNANCY
	FATIGUS/LACK OF ENERGY/WEAK HANDS-FEET
	HANSEN'S DISEASE
	HEADACHES
	HEART SURGERY
	HEAVY ALCOHOL DRINKER
	HEAVY TOBACCO SMOKER
	HYPERTENSION/HIGH BLOOD PRESSURE
	HYPOTHYROID/PARATHYROIDECTOMY
	HYSTERECTOMY/ D & C
	IMPETIGO
	LOSS OF SMELL
	LYMPH NODE ENLARGEMENT
	MALNOURISHMED
	MENINGITIS
	MIGRAINE/HEADACHES
	MULLOSCUM CONTAGIOSUM
	NASAL LESIONS
	NERVOUNESS/TENSE
	NO APPETITE
	NUMBNESS/HAND/LEG/TOE/PARATHESIASES
	OTITIS
	OVARIAN CANCER
	PARASTHESIAS
	PAST MEDICAL HISTORY - HIGH FEVER
	PERIPHERAL VASCULAR DISEASE
	PID- PELVIC INFLAMMATORY DISEASE
	PNEUMONIA
	POSSIBLE HYPERTHYROID
	POSSIBLE MENINGITIS
	PSORIASIS/ECZEMATIS
	SCABIES
	SUPRACLAVICULAR MASS
	SVR IMPETIGO

Etiology	Diseases
	TETANY
	THYROID NODULES
	THYROIDECTOMY
	TRIGEMINAL NEURALGIA
	TUMOR/BONE/ABDO./GYNEC/BREAST/SCALP/SKIN
	ULCER
	URI - UPPER RESPIRATORY INFECTION
	UTI - URINARY TRACK INFECTION
	VISION PROB./CATARACTS/MYOPIA...
	WEIGHT LOSS
4 MULTIPLE FACTORS	DIED AFTER BIRTH
	EPILEPSY
	HAD A CHILD W/ SEVERE DEV. PROBLEMS
	HAD A MENTALLY HANDICAPPED CHILD
	HAD A SEVERELY DEFECTIVE CHILD
	MISCARRIAGE
	OBESITY
	SMALL LIPOMA ABD
	STILLBIRTH

Groups	Diseases
1 INFECTIOUS DISEASES	AMEBIC DYSENTRY
	BRONCHITIS
	CHEST ABCESS
	CHICKEN POX
	CHILD DIED WITHIN 1 YEAR OF BIRTH--INFEC
	CONJUNCTIVITIS
	HANSEN'S DISEASE
	IMPETIGO
	MENINGITIS
	MULLOSCUM CONTAGIOSUM
	OTITIS
	PNEUMONIA
	POSSIBLE MENINGITIS
	PSORIASIS/ECZEMATIS
	SCABIES
	SVR IMPETIGO
	TETANY
	URI - UPPER RESPIRATORY INFECTION
	UTI - URINARY TRACK INFECTION
2 REPRODUCTIVE	CAESARIAN SECTION
	CHILD DIED WITHIN 1 YEAR OF BIRTH--CONGE
	DIED AFTER BIRTH
	ECTOPIC PREGNANCY
	HAD A SEVERELY DEFECTIVE CHILD
	HYSTERECTOMY/ D & C
	INFERTILITY
	MISCARRIAGE
	PID- PELVIC INFLAMMATORY DISEASE
	STILLBIRTH
3 TUMOURS	BIOPSY/THYROID/ABD/BREAST/NECK
	CANCER/TONGUE/STOMACH/BREAST
	CERVICAL DYSPLASIA
	CERVICAL NODE ENLARGEMENT
	LYMPH NODE ENLARGEMENT
	NASAL LESIONS
	OVARIAN CANCER
	SMALL LIPOMA ABD
	SUPRACLAVICULAR MASS
	TUMOR/BONE/ABDO./GYNEC/BREAST/SCALP/SKIN
4 THYROID RELATED	HYPOTHYROID/PARATHYROIDECTOMY
	POSSIBLE HYPERTHYROID
	THYROID NODULES
	THYROID RELATED
	THYROIDECTOMY
5 SERIOUS MEDICAL PROBLEMS	ACNE
	AMPUTATION
	ANEMIA / MUSCOSAL PALLOR
	ANKYLOSING SPONDYLITIS
	ARTHRITIS/CERVICAL/ARTHRALGIA/KNEES
	ASTHMA
	CHOLECYSTECTOMY
	DEPRESSION/EMOTIONAL PROB.

Groups	Diseases
	DEV. DELAY (POSSIBLY MENINGITIS-RELATED)
	DIABETES
	EPILEPSY
	FACIAL ASSYMETRY
	GLUCOSURIA
	HEARING PROB.
	HYPOGLYCEMIA
	NUMBNESS/HAND/LEG/TOE/PARATHESIASES
	OESOPHAGAL SPASM
	OTHER
	PARASTHESIAS
	PAST MEDICAL HISTORY - HIGH FEVER
	PERIPHERAL VASCULAR DISEASE
	PHYSICAL PROBLEM/LIMP/PARAPALEGIC
	PROTEINURIA
	REFLUX ESOPHAGITIS
	SVR. MED. PROB.
	TRIGEMINAL NEURALGIA
	ULCER
	UNDIAGNOSED CNS PATHOLOGY
	VISION PROB./CATARACTS/MYOPIA...
	VITILIGO
6 OTHER SYMPTOMS OF POOR HEALTH	ABDOMINAL PAIN
	ASCARIS
	BACKACHE
	BODY ACHES/PAIN/FACIAL/BURSITIS/FEET/KNE
	CHRONIC COUGH
	DENTAL CARIES
	DIARRHEA
	DIZZY SPELLS
	FATIGUS/LACK OF ENERGY/WEAK HANDS-FEET
	HEADACHES
	HEAVY ALCOHOL DRINKER
	HEAVY TOBACCO SMOKER
	LOSS OF SMELL
	MALNOURISHMED
	MIGRAINE/HEADACHES
	NERVOUNESS/TENSE
	NO APPETITE
	OBESITY
	SMALL FOR AGE
	WEIGHT LOSS
7 GENERAL PHYSICAL ABNORMALITIES	BIRTH DEFECT
	BOW LEGS
	DOWN'S MOSAIC
	DOWN'S SYNDROME
	ESOTROPIA
	HAD A CHILD W/ SEVERE DEV. PROBLEMS
	HEMANGIOMA
	HIP DYSPLASIA
	INGUINAL HERNIA
	KYPHOSIS

Groups	Diseases
	LOSS OF NASAL BRIDGE
	ORGANOMEGALY
	PECTUS CARINATUM
	PECTUS EXCAVATUS
	PHYSICAL DEFORMITY
	POSSIBLE EPILEPSY
	TURNER'S SYNDROME
	UMBILICAL HERNIA
8 HEART	BRADYCARDIA
	CORONARY ARTERY DISEASE WITH ANGINA
	HEART MURMUR
	HEART SURGERY
	HYPERTENSION/HIGH BLOOD PRESSURE
	STROKE
9 MENTAL & NEURO'L ABNORMALITIES	AUTISM
	HAD A MENTALLY HANDICAPPED CHILD
	HYDROCEPHALUS
	MENTALLY HANDICAPPED/LEARNING PROB.
	SPINA BIFIDA

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A REPORT
TO THE U.S. CONGRESS
ON THE HEALTH PROBLEMS
OF RONGELAP PEOPLE

June 1989

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