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DOE/EH-0493
PB95 -
July 1995

BNL-52470
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MEDICAL STATUS OF MARSHALLESE ACCIDENTALLY EXPOSED TO 1954 BRAVO FALLOUT RADIATION; JANUARY 1988 THROUGH DECEMBER 1991

July 1995

PREPARED FOR U.S. DEPARTMENT OF ENERGY
OFFICE OF ENVIRONMENT, SAFETY AND HEALTH
OFFICE OF INTERNATIONAL HEALTH STUDIES

Under Contract No. DE-AC02-76CH00016

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MEDICAL STATUS OF MARSHALLESE ACCIDENTALLY EXPOSED TO 1954 BRAVO FALLOUT RADIATION; JANUARY 1988 THROUGH DECEMBER 1991

By

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July 1995

Work Performed Under Contract No. DE-AC02-76CH00016

Prepared for
U.S. Department of Energy
Assistant Secretary for Environment, Safety and Health
Office of Health

FOREWORD

As part of the United States atmospheric nuclear weapons testing program between 1946 and 1958, 23 nuclear devices were detonated at the Bikini Atoll and 43 nuclear devices were detonated at the Enewetak Atoll. A 1954 nuclear weapons test on the Bikini Atoll, test shot code named Castle Bravo, produced a nuclear yield much higher than anticipated. The levels and dispersion of the radioactive fallout from Castle Bravo were significantly greater than originally expected. This resulted in radioactive fallout on the inhabited atolls of Rongelap and Utrik. The Rongelap and Utrik people were evacuated from their contaminated atolls 48 and 72 hours, respectively, after the Castle Bravo test shot. The original population directly exposed to the fallout from Castle Bravo consisted of 241 individuals and 12 fetuses. Absorbed dose estimates for the exposed population were in the order of 0.11 to 1.9 Gray (11 to 190 Rad) to the whole body and from 1.9 to 200 Gray (190 to 20,000 Rad) to the thyroid.

Public Law 99-239 mandated that the Government of the United States would "continue to provide special medical care and logistical support to...the remaining population of the Rongelap and Utrik who were exposed to radiation resulting from the 1954 Bravo test." The Department of Energy (DOE), through its contract with the Brookhaven National Laboratory Medical Department, implements this congressional mandate.

The present DOE Marshall Islands medical surveillance program consists of two field missions per year. The purpose of the program is to provide medical care and treatment for radiologically related problems for those Marshallese who were exposed to fallout from the 1954 Castle Bravo test. As of December 1991, the originally exposed population consisted of 159 individuals. The medical surveillance program offers, on a voluntary participation basis, an annual physical examination to these individuals, as well as annual physical examinations to a comparison/control unexposed population.

The medical surveillance procedure includes a complete annual physical examination, which is based on the criteria established by the American Cancer Society. Typical medical missions included specialists in gastroenterology, hematology, obstetrics/gynecology, endocrinology, oncology, radiology, cardiology, nephrology, pulmonology, and rheumatology.

This, the 16th report of the Marshall Islands Medical Program, disseminates information concerning the medical status of the 253 Marshallese exposed to the fallout from the 1954 Castle Bravo test shot.

Harry J. Pettengill, Ph.D.
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Office of International
Health Studies

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EXECUTIVE SUMMARY

Introduction

As a result of the radiation exposure of individuals on the Marshall Islands atolls of Rongelap and Utrik shortly after test shot Castle Bravo, the United States began providing surveillance and health care associated with radiation related diseases to those individuals exposed. This responsibility was codified into law by Public Law 95-134 (1977) and Public Law 99-239 (1986). The distribution of the initially exposed group was as follows: 64 persons on Rongelap, plus 3 fetuses; 18 persons on Ailingnae, plus 1 fetus; and 159 persons on Utrik, plus 8 fetuses. In later years, the Ailingnae have been combined into the Rongelap population. The Department of Energy's (DOE) Office of Environment, Safety and Health is responsible for ensuring that the Marshallese who were exposed to radiation during Castle Bravo in 1954 receive medical care and treatment for any injury, illness, or condition that may be the result, directly or indirectly, from their exposure to the fallout from Castle Bravo. For the last 37 years, the Brookhaven National Laboratory (BNL), under contract to DOE, has provided the required health care and surveillance for this program. In addition to conducting surveillance of the exposed Marshallese group, BNL has been monitoring a cohort of unexposed Marshallese. The individuals in this cohort were selected to mirror the age, sex, etc., distribution of the exposed group. Currently, there are approximately 154 of the exposed population and 115 of the unexposed population being monitored. This report discusses the medical care provided and the medical findings for the years 1988-1991.

Procedure

In the spring and fall of each year, the BNL medical team visits the islands of Mejatto, Utrik, Ebeye, and Majuro to provide medical surveillance to the exposed and unexposed cohorts. The medical team is composed of BNL personnel, DOE Headquarters personnel, staff of the Marshallese Government Health Services, and volunteer physicians from various universities and government and private institutions in the United States. The medical team travels from island to island on a DOE leased vessel. The vessel has examination facilities and is capable of doing basic laboratory work. Blood samples for more complex tests, such as Thyroid Stimulating Hormone tests, are frozen and taken to BNL. The following examinations are performed during the medical visits:

A. A cancer-related examination as defined by the American Cancer Society;

- o A review of systems and a complete medical examination;
- o Pelvic examinations with Papanicolaou smears;
- o Stool testing for occult blood;
- o A mammogram for females;
- o A flexible sigmoidoscopy for females and males; and
- o Advice on decreasing risk factors and on self-detection of lesions.

B. An annual thyroid examination and thyroid function testing;

C. Serum prolactin testing looking for pituitary tumors;

D. Annual blood counts to include platelets; and

E. Evaluation for paraneoplastic evidence of neoplasms.

Medical Findings

During the last 4 years, 95 percent of the exposed population from Rongelap, 98 percent of the exposed population from Utrik, and 90 percent of the comparison population have been examined at least once. Those persons not residing in the Marshall Islands are seen by a physician in their locality.

After 37 years, there is little difference between the longevity curves of the Rongelap group, the Utirik group, and the unexposed cohort population. Each of the deaths (4 exposed and 10 nonexposed) that have occurred during the report period is discussed later in the report. The Marshallese population has a high incidence of diabetes, and it appears that one of the deaths of the exposed population and five of the deaths of the unexposed population were diabetes related.

There is a mild, but relatively consistent depression of neutrophil, lymphocyte, and platelet concentrations in the blood of the exposed population. This depression appears to be of no clinical significance. Thyroid hypofunction, either clinical or biochemical, has been documented as a consequence of radiation exposure in 14 exposed Rongelap individuals. During this reporting period, one exposed person was diagnosed as having a basal cell carcinoma. Previously, one other exposed person had been diagnosed as having basal cell carcinoma. During this reporting period, a thyroid nodule was identified in an individual who was one of those who was in utero at the time of the exposure. Upon pathologic review, the nodule was diagnosed as occult papillary carcinoma.

DEDICATION

This report is dedicated to Dr. Brown M. Dobyns, M.D., Ph.D. Dr. Dobyns first volunteered to serve as thyroid surgeon and consultant to the Marshall Islands Medical Program in 1969. He subsequently participated in ten medical missions to the Marshall Islands. Dr. Dobyns' compassion, skill, respect for Marshallese customs, and personal involvement with the welfare of our Marshallese patients tempered the emotional and physical duress of undergoing thyroid surgery at a major U.S. medical center where the number of hospital employees alone far exceeded the population of their home island. His concern and graciousness were amplified in the warmth and courtesy of the staff of Cleveland Metropolitan General Hospital, particularly that of the Surgical Service.

Dr. Dobyns recently retired from his position in the Department of Surgery, Case Western Reserve University, where he is currently Emeritus Professor of Surgery. One of his undertakings since retirement has been the publication of a comprehensive review of approximately eighty thyroid surgeries performed on the Marshallese during his involvement with the Brookhaven medical program (Dobyns and Hyrmer, 1991). Although our thyroid surgeries are now performed at the Clinical Center, the National Institutes of Health, we know that Dr. Dobyns will continue to extend to us the benefits of his medical wisdom and, occasionally, the pleasure of his company.

CONTENTS

INTRODUCTION

This is the 16th report of the Marshall Islands Medical Program prepared by Brookhaven National Laboratory (BNL). The purpose of these publications is to disseminate information concerning the medical status of 253 Marshallese exposed to fallout radiation in 1954. In so doing, the medical program is fulfilling a commitment incumbent on all health care organizations; i.e., to disclose in a timely fashion unique medical information relevant to the public health. Details of the BRAVO thermonuclear accident that caused the exposure have been published, and a 1955 article in the *Journal of the American Medical Association* describing the acute medical effects in the exposed population remains a definitive and relevant description of events (Cronkite et al., 1955).

Participation in the Marshall Islands Medical Program by the exposed Marshallese is voluntary. Throughout the 36 years of this program, each participating exposed individual's relevant medical findings, laboratory data, and disease morbidity and mortality have been published in the Brookhaven reports in a manner preserving patient confidentiality. Also, in each report, there has been an attempt to interpret these findings and to infer the role of radiation exposure in their development. But an equally important aspect of the reports has been presentation of the actual data so that readers can apply their own analyses to questions pertaining to the medical consequences of the Marshallese exposure.

EXPOSURE GROUPS

The exposed Marshallese population originally was comprised of 64 persons on Rongelap Atoll who each received an estimated 190 cGy of whole-body external gamma radiation, 18 on Ailingnae Atoll (Sifo island) who each received 110 cGy, and 159 on Utirik Atoll who each received 11 cGy. In addition, there were 12 women who were pregnant at the time of the accident (3 on Rongelap, 1 on Ailingnae, and 8 on Utirik), each of whom received whole-body doses equivalent to others in the same atoll. The twelve individuals exposed in utero became a part of the exposed population after birth. Because of radioiodines in the fallout, the thyroid gland received an exposure that was much greater than the whole-body dose, the magnitude of which was a function of age at the time of exposure (Lessard et al., 1985). In December 1991, the number of surviving exposed persons was: Rongelap - 48, Ailingnae - 11, and Utirik - 100. For most purposes in this report the Rongelap and Ailingnae groups are treated as one and referred to as the Rongelap group, because those persons exposed to fallout on Ailingnae were Rongelap inhabitants temporarily residing on this nearby atoll.

The Marshall Islands Medical Program also examines a comparison group that dates from 1957 when 86 unexposed people from Rongelap were selected. The makeup of the group approximated, in age and gender, that of the exposed Rongelap population (Conard et al., 1958). In December 1991, 56 persons remained in this group. From 1962 to 1978 additional persons were added as a second comparison group in order to supplement and replace persons lost from the original group. This group was also matched by age and gender to the exposed population and was similar to the 1982 Rongelap and Utirik exposed groups. In December 1991, the total population of the two comparison groups was 115. As in previous reports, it is the expanded unexposed population that is used in this report for comparisons of year-to-year medical events and for causes of death; this provides baseline prevalences of disease in the community from which unexpected consequences of the fallout exposure can be identified. They are also used to compare survival rates of the exposed population to the unexposed population.

THE MARSHALL ISLANDS MEDICAL PROGRAM

Policies:

The mandate of the program, as formulated by the U.S. Congress most recently in 1980 (PL 96-205, Sec. 106 (a)), specifies "...a program of medical care and treatment....for any injury, illness, or condition which may be the result directly or indirectly of such nuclear weapons testing program." Subsequently, in 1985, the Compact of Free Association between the U.S. and the Republic of the Marshall Islands provided for radiation injury compensation to be managed by the Marshallese themselves. However, a subsidiary agreement, in response to a request from the Republic of the Marshall Islands, has permitted the Brookhaven medical program to continue to supplement local health care for the exposed persons, stating "..the President....shall continue to provide special medical care and logistical support thereto for the remaining 174 members of the population of Rongelap and Utirik who were exposed to radiation resulting from the 1954 United States thermonuclear "Bravo" test, pursuant to Public Laws 95-134 and 96-205."

The Marshall Islands Medical Program is a clinical program which exists for the benefit of the radiation-exposed Marshallese. It is a program of radiation-related disease surveillance consisting of periodic examination and treatment of disease. Additionally, clinical investigations have been carried out by the program over the years, the intent being to identify present or future threats to the health of the exposed Marshallese, hopefully in time to prevent or limit morbidity and mortality. For example, based on the medical program's early findings of numerous thyroid nodules in the exposed population, thyroxine suppression was initiated for the Rongelap people in 1965 so that thyroid nodules/carcinoma might be prevented. It is possible that this prophylaxis has met with some success. This will be discussed in detail below.

The Marshall Islands Medical Program is distinct from the Marshallese Government Health Services, which is a national program of health care which encompasses two hospitals and a network of clinics scattered over some 20 atolls. This network serves the entire population of the Marshall Islands, which numbers over 45,000, whereas the U.S.-funded medical program is directed to assist only those individuals who were exposed to fallout radiation from the BRAVO accident.

The Marshall Islands Medical Program provides medical care twice yearly to the exposed and comparison populations by visiting the islands where most now reside, namely Mejatto, Utirik, Ebeye, Majuro, and, prior to 1985, Rongelap.

Any exposed person who has medical findings suggesting a malignant neoplasm, or other radiation related disease, is referred to secondary or tertiary medical facilities for definitive evaluation and therapy. Those persons with problems that can be effectively managed in Majuro are referred to the Marshallese Health Services. Those requiring a more extensive evaluation are referred to hospitals in Honolulu or, for the special cases of thyroid and pituitary lesions, the National Institutes of Health in Bethesda, Maryland. Individuals needing referral for non-radiation related problems are referred to the Marshallese Health Service where immediate treatment is initiated.

During the process of providing medical surveillance to the exposed Marshallese, the physicians of the medical program come into contact with children and other family members of the exposed, as well as other inhabitants of the islands. It has been the policy of the Department of Energy to support the medical program in its efforts to provide medical consultations by the medical specialists on the mission to these individuals on the basis of humanitarian need and as resources permit. In addition, services of the Brookhaven medical team and its facilities are offered to the Ebeye and Majuro hospitals. On most visits lectures by team physicians are arranged and patients referred from the hospitals are evaluated.

The medical direction of the Marshall Islands Medical Program and the organization of the medical missions to the Marshall Islands are centered at Brookhaven National Laboratory. The staff of the program includes a physician-director, an administrator, and a medical associate at the Laboratory, and a Marshallese laboratory technician on Ebeye. At the time of the missions a variety of physicians are chosen for the medical team. They are skilled volunteers, primarily selected from the staff of university-affiliated or government hospitals, and often with past experience with the program. Direct management of thyroid disease at the time of medical examination is in the hands of the endocrinologist on the medical team. Dr. Jacob Robbins, Chief of the Endocrinology Section, Genetics and Biochemistry Branch, National Institutes of Health, Bethesda, MD. provides overall management of the thyroid disease facet of the medical program. Raytheon Services Nevada, Inc., Honolulu, Hawaii, under contract to DOE, provides excellent logistical support to the Department of Energy. The Marshall Islands government, provides on request, nurses, translators, and other health care workers for each mission.

In the interim between the two medical missions the exposed population has access to the Marshallese health care system. To expedite exchange of medical information, with the permission of the examinees, copies of all examination and laboratory data from the Brookhaven program are forwarded to the Marshall Islands Health Service hospitals on Ebeye and Majuro and to the 177 Health Care Program, a special program set up for persons from the radiation-affected atolls, with administrative offices at the Majuro hospital. In addition, copies of the examinations and laboratory data are given to the examinees themselves.

The Marshall Islands Medical Program, as a satellite clinic of the Clinical Research Center, Brookhaven National Laboratory, is accredited by the Joint Commission on Accreditation of Healthcare Organizations, a nationwide organization that sets standards of performance for institutions dispensing medical care and monitors compliance with those standards. By voluntarily participating in the accreditation process, the Brookhaven National Laboratory Marshall Islands Medical Program receives a valuable and impartial external review of its policies and procedures, as well as an assessment of the adequacy of the services it provides. Laboratory and radiological services, medical records, patient satisfaction, pharmaceutical services, and clinical competence of physicians are among the many items reviewed by the Joint Commission.

Procedures:

The exposed population, which in December 1991 numbered 159, must be considered at increased risk for malignant disease as a late complication of radiation exposure. Therefore, the medical program has in place a cancer-oriented annual health evaluation. The examination follows the guidelines of the American Cancer Society and includes a medical history, complete physical examination, advice on decreasing the risk factors for cancer, advice on self-detection of lesions, annual pelvic examinations and Papanicolaou smears, blood count, urinalysis, stool testing for occult blood, annual mammography (offered to all exposed women and to all unexposed women forty years of age or older), and flexible sigmoidoscopy (every three years for persons fifty years of age or older).

Every two years ophthalmologists are included on the medical team and slit-lamp examinations are provided. A wide selection of reading glasses and glasses for aphakic individuals are included on each mission. These glasses, of great practical value to the island populations, have for years been kindly provided free of charge by New Eyes for the Needy (P.O. Box 332, Short Hills, NJ).

It is known, because of earlier medical program observations, that the exposed are at increased risk for certain endocrine problems. Therefore, they receive annual thyroid function blood tests and thyroid examinations by a specialist in endocrinology or thyroid surgery. Needle biopsies of thyroid nodules were performed on selected patients in an effort to avoid surgery and the subsequent loss of normal thyroid tissue. Other serologic tests are performed on a regular basis in an attempt at early detection of malignant nonthyroidal lesions. These include serum protein electrophoresis, calcium, prolactin, alpha-fetoprotein levels on persons known to have hepatitis B surface antigenemia, and thyroglobulin determinations on those whose thyroid surgery specimens suggested a malignant lesion. There is also ongoing monitoring for clinical evidence of immune competence, for exposed persons may be at increased risk for infectious disease or unusual manifestations thereof. Specialized tests on the comparison population were referred as clinically indicated.

Medical examinations and services performed during this four-year reporting period were conducted primarily aboard the Liktanur III, owned by U.S. Oceanography, San Diego, CA, and the G. W. Pierce, a vessel owned by Tracor Marine, Ft. Lauderdale, FL. These ships were chartered by the U.S. Department of Energy for the purpose of supporting several of the Department of Energy-sponsored Marshall Islands programs, of which the medical program is but one. Some patients were examined in the island dispensaries on Mejatto and Utirik, and home visits were arranged for the elderly who preferred not to be moved aboard the ship.

Clinical laboratory services for the missions were performed by several Brookhaven National Laboratory technicians with support from personnel of the Health Services of the Republic of the Marshall Islands. Routine hematology testing was performed on a J.T. Baker 5000 electronic counter and, beginning in the fall of 1989, on the Serono Baker 9000 RX automatic 8-parameter cell counter. Leukocyte differentials and platelet counts were part of each evaluation. Clinical chemistry tests were performed on Eastman Kodak EktaChem DT60, DTSC or DTE analyzers. These analyzers provide a wide variety of basic chemistry tests with a small amount of disposable waste. Urinalysis included a dip-stick examination and, when indicated, microscopic analysis. Stool exams were performed on physicians' request for identification of parasites and occult blood, although the physicians routinely perform a test for occult blood at the time of examination.

Roentgenographic services were provided using a dedicated mammography unit and a standard x-ray unit manufactured by the Bennett Corporation, Long Island, NY. X-ray interpretation was done at the time of examination. However, if no radiologist was part of the medical team, the x-ray films were returned to Brookhaven National Laboratory and then referred to a consultant radiologist, Dr. R. Naylor, at the University of Vermont.

A portable, battery powered, electrocardiograph machine was available. Electrocardiogram interpretation was done at the time of examination, with a copy often being given to the patient. All electrocardiograms were subsequently returned to Brookhaven National Laboratory and then referred to a consultant cardiologist (Dr. M. Zema) at Brookhaven Memorial Hospital on Long Island, NY, for definitive analysis.

In recent years an ultrasound machine (Hewlett Packard Sonos 100) has been available on the ship for assessment of such diverse items as abdominal pain, hematuria, gestational age, and cardiac disease. It is used only when a radiologist or subspecialist physician with expertise in ultrasound examination is part of the team. Ultrasound has been available to confirm findings on physical examination of the thyroid but this requires special planning and an investigator experienced in thyroid ultrasound. It was not used to screen for subclinical thyroid nodularity.

Sera collected during the routine physical examinations were analyzed at the time of patient examination, as clinically indicated. The remainder was frozen for further testing upon return to Brookhaven National Laboratory. The latter tests were performed at the Brookhaven Clinical Laboratory or referred to university and commercial laboratories. Among the referral laboratories were: Hazelton Washington, Inc., Vienna, VA, for hormone assays; Michael Reese Hospital and Medical Center (Dr. A.B Schneider, Division of Endocrinology and Metabolism), Chicago, IL for thyroglobulin analysis; MetPath, Teterboro, NJ; Smith Kline Beecham (Accupath), Honolulu, HI; and Smith Kline Bio-Science, King of Prussia, PA. Pathologists' Laboratories, Inc. in Aiea, HI, was the primary source for Papanicolaou smear and cytology interpretations.

Quality control/quality assurance is an important focus of the medical program. Accreditation by the Joint Commission on Accreditation of Healthcare Organizations is one manifestation of this. In the laboratory quality control and quality assurance involves routine calibration, maintenance and monitoring of all instrumentation. Daily tri-level analysis of reference materials is performed on the hematology analyzer. The chemistry analyzer is calibrated prior to each mission, and bi-level quality control samples are run on all analyses. Approximately 10 percent of all chemistry tests performed in the field are re-analyzed at Brookhaven National Laboratory to compare with and to confirm the earlier results all of which proved to be within acceptable tolerance. When necessary, laboratory instrumentation is inspected and repaired by company service representatives. Other instrumentation, such as sphygmomanometers, electrocardiograph machines, doppler units, are periodically calibrated and have routine preventative maintenance performed at Brookhaven National Laboratory between missions.

Other quality assurance methods include the use of questionnaires given to patients. These questionnaires, translated into Marshallese, with the responses being interpreted at the present time by Mr. Alfred Capelle, Director of the Marshall Islands Alele Museum in the Republic of the Marshall Islands in Majuro, solicit criticism and advice for improving the medical program's operation. One important quality assurance mechanism is the involvement of volunteer physicians from around the United States, for this rotation through the program of new medical eyes and ears keeps the medical program attuned to newer or better approaches to diagnosis and management. In addition to information obtained by personal interaction during the missions, ideas for bettering the program are requested via a questionnaire distributed to all professional personnel at the end of each mission. Finally, the results of these and other mechanisms of quality assurance are reviewed by the Brookhaven National Laboratory Clinical Research

Center Quality Assurance and Care Committee. Also included in that review are items such as the appropriateness of the use of anti-infective agents. A certified medical records consultant randomly reviews approximately 20 percent of our records for accuracy and completeness.

Staff:

The Marshall Islands Medical Program is deeply indebted to the many outstanding physicians who, despite the inevitable personal inconvenience, participated in the medical team visits of 1988-1991. It is fair to say that they are the heart of the program. Drawn from excellent medical centers through the United States and from private practices, these physicians provide the program with a wide range of up-to-date clinical experience and perspective that contribute to better patient care. The physicians and other medical team personnel involved in the 1988-1991 missions are listed in Appendix A. The clinical role of team physicians is the delivery of primary and subspecialty care. By selecting subspecialists who remain active in general medicine for this role, the medical program benefits from in-depth knowledge of their specialty. The following medical specialties and subspecialties were represented in 1988-1991:

- Internal Medicine
- Pediatrics
- Cardiology
- Rheumatology
- Radiology
- Gastroenterology
- Hematology
- Endocrinology
- Surgery
- Ophthalmology
- Obstetrics/Gynecology
- Pulmonary Medicine
- Emergency Medicine
- Oncology

MEDICAL FINDINGS

Patient Participation:

The participation of many excellent medical specialists undoubtedly has been a major factor in the acceptance of the Marshall Islands Medical Program by the population it serves, for utilization of the program is entirely voluntary. The percent of persons in the exposed and Comparison groups who appear for examination remains high. For the current reporting period the annual acceptance rates (corrected for nonavailability) were:

	1988	1989	1990	1991
Rongelap	86%	82%	88%	85%
Utirik	84%	91%	85%	87%
Comparison	68%	62%	65%	60%

The percent of the eligible population examined on at least one occasion during the last four-year period was:

Rongelap	95%
Utirik	98%
Comparison	90%

These figures do not include several persons residing outside the Marshall Islands. Most exposed persons in this category have medical examinations arranged through a local physician by the Department of Energy or the Marshall Islands Medical Program.

The acceptance rate for mammography among eligible women was 100%. For sigmoidoscopy, about 75% of age-eligible persons elected to undergo this procedure on a regular basis.

Overall Survival:

After 37 years there continues to be little difference between the survival curves of either the high-exposure Rongelap group or the low exposure Utirik group and the age- and gender matched unexposed Rongelap population selected in 1957 (Fig. 1). Estimates of the survival distribution by the actuarial life table method were analyzed by the Mantel-Cox and Breslow statistics for testing the equality of the survival curves. The "p" values for the two tests were 0.66 and 0.82, respectively, for the Rongelap and Comparison group, and 0.43 and

0.40 for the Utirik and Comparison group, indicating no statistically significant differences.

Causes of Recent Mortality:

The number of deaths occurring in 1988 through 1991 is as follows: Rongelap - 1: Utirik - 3: expanded Comparison group - 10 (see p. 1 for the description of this group). The clinical events surrounding the deaths are described below.

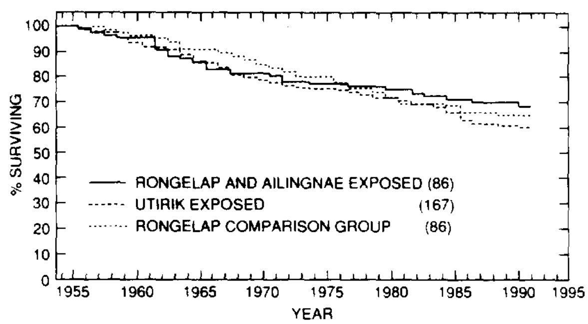

Fig. 1: Percent survivors of the different exposure groups since 1954. The number of persons initially in each group is shown in parentheses.

Rongelap:

Subject No. 1. Advanced complications of diabetes mellitus were the cause of death in December 1991 of this 58-year-old man. He had been referred to the Straub Clinic in Honolulu a month earlier for a scheduled colonoscopy because of a history of colonic adenomatous polyps. At that time no evidence of malignant disease was uncovered, and chronic renal failure was felt to explain the anemia, abnormal mental status, and neuropathy that had been developing in recent years.

Utirik:

Subject No. 2. The death certificate of this 54-year-old woman lists "sepsis" and "diabetic gangrene/cellulitis (left) foot" as her cause of death in April 1991. She had diabetes mellitus with retinopathy and probably nephropathy, and she was last seen by the medical team in March 1990. At that time she had a guaiac-positive stool felt to be due to hemorrhoids. Her mammogram was "negative" and her Papanicolaou smear was normal. An alpha-fetoprotein level was normal (she was known to be hepatitis B surface antigen-positive), and a chest x-ray showed only pectus excavatum.

Subject No. 3. This 52-year-old man, a cigarette smoker, died in 1990; death certificate cause of death: malignant lymphoma with marked gastric involvement. When last seen by the Brookhaven medical team (April 1989) the patient had borderline hypertension requiring no therapy. No lymphadenopathy or splenomegaly was noted. He had symptoms consistent with esophageal reflux, for which he was given antacids. His blood count, urinalysis, stool guaiac and electrocardiogram were normal. A chest x-ray had been normal in 1988, and a flexible sigmoidoscopy was normal in 1987. His serum was known to be positive for hepatitis B surface antigen, but the alpha-fetoprotein level was normal in 1988 (2.5 ng/ml). The death certificate diagnosis was made on clinical grounds. No tissue diagnosis was possible. The patient died while departing Majuro to have an evaluation in Honolulu for his dysphagia and weight loss.

Subject No. 4. This 80-year-old woman died on Utirik in 1988; in recent years she had become severely incapacitated with shortness of breath and arthritis of the shoulder. A medical team cardiologist diagnosed mitral regurgitation (secondary to ruptured chordae tendineae) and mild aortic stenosis/insufficiency. She was on digoxin and hydralazine for this. The joint problem, which was due to a shoulder injury at an early age and subsequent degenerative changes, was handled with acetaminophen. Her blood count when seen in March 1988 was normal except for a mild anemia (hemoglobin: 10.1 g/dl), present since 1984 (hemoglobin: 10.6 g/dl). Serum creatinine was normal in 1987, as was a Papanicolaou smear. Because of restricted mobility her medical exams were done in her home. She was unchanged clinically when last seen in September 1988. The cause of death is unknown.

Comparison population:

Subject No. 5. This 67-year-old man died on Ebeye in 1988. When last examined by the Brookhaven team (1985) his medical problems included marked obesity and chronic renal failure of unknown cause. There was no diabetes, and his urinary sediment showed red cells, casts and protein. The serum creatinine was 3.4 mg/dl. He had chronic venous insufficiency in the legs and a left hydrocele. A serologic test for filaria was negative. There was also a mild macrocytosis; a serum B12 level was low normal. The cause of death is not known.

Subject No. 6. This 69-year-old man died on Ebeye in 1989. His medical problems in March 1988 included diabetes (status post leg amputation) with chronic renal failure, severe neuropathy, and eye infection from recent cataract extraction, for which he was referred. He was moderately anemic with a Hb of 9.6 g/dl. The cause of death is unknown.

Subject No. 7. This 42-year-old man died on Majuro in 1989. He had diabetes, extremely carious teeth, a cataract, and a disabling arthrogryposis. When last seen in 1989 his only medication was glyburide. His blood count and serum creatinine were normal. He was referred for cataract surgery. The death certificate lists overwhelming sepsis and severe pneumonia as the cause of death.

Subject No. 8. This 89-year-old woman died on Ebeye in 1990. No important medical problems were noted when patient was last seen in March 1988. She had severe kyphosis, cataracts, and perhaps a mild dementia, but in general annual examinations indicate she was usually in quite good health. Her blood count was normal and a Papanicolaou smear was Class I in 1988. Medications included only acetaminophen and a skin antifungal agent. The cause of death is unknown.

Subject No. 9. This 76-year-old woman died on Ebeye on December 31, 1987. The death certificate diagnoses were cardiac failure and bronchitis. At the time of her last complete medical examination by the Brookhaven team she had a moderately severe anemia (hemoglobin level: 8.8 g/dl) and recent weight loss. The mean corpuscular volume was 98 fl. and there was some hypersegmentation. A serum B12 level was somewhat low (170 pg/ml), but the urine methylmalonic acid level was normal at 0.8 ug/mg creatinine. Nevertheless, she was started on intramuscular B12. Mammography was normal and her Papanicolaou smear was class I. When seen several months later in follow-up, she felt well. A flexible sigmoidoscopy was normal. It may be relevant that her husband had died recently, and it is possible that he had advanced tuberculosis.

Subject No. 10. This 59-year-old man died on Ebeye in 1990. He had advanced diabetes mellitus with nephropathy, retinopathy, and neuropathy. When last seen in March 1990 his creatinine was 12.4 mg/dl and the hemoglobin level was 10.4 g/dl. A HbA1c level was 6.8%, only slightly elevated. Flexible sigmoidoscopy was negative in 1987, and a chest x-ray at that time showed no active disease. He was being followed by the Diabetic Clinic on Ebeye. His death certificate listed renal failure due to diabetic nephropathy as the cause of death.

Subject No. 11. This 61-year-old man, a former heavy smoker, died on Majuro in 1989. He was known to have chronic renal insufficiency thought to be due to diabetes. He was referred in 1987 for evaluation of this problem. An ultrasound examination by the Brookhaven team revealed no calculi or hydronephrosis; renal size appeared normal. He had gout, and the renal disease could have represented uric acid nephropathy. There was a suggestion of pleural effusions on chest x-ray in 1988 when he was referred for further evaluation. When next seen by the medical team in March 1989 he had lost much weight and a hilar mass was noted on chest x-ray. He was referred for evaluation. Carcinoma of the lung was indicated on his death certificate.

Subject No. 12. This 73-year-old woman had breast cancer diagnosed in 1985 after a breast nodule was detected during her annual medical program physical examination. A mastectomy was done that year. She died in 1991. When last seen by the medical team (March 1989) there was no evidence of metastatic disease, and the cause of death is unknown.

Subject No. 13. This 64-year-old woman died on Ebeye in 1988. Her last complete Brookhaven examination was in 1986, when her problems included insulin-dependent diabetes mellitus, urinary tract infection, and abnormal liver function tests. When repeated, the latter showed only a minimally elevated alkaline phosphatase. A flexible sigmoidoscopy and mammography were negative, blood count was normal, and Papanicolaou smear was class I. She had carcinoma of the endometrium in 1979 which was effectively treated by total abdominal hysterectomy. Septicemia and nonketotic hyperosmolar diabetic coma were listed on her death certificate as the causes of death.

Subject No. 14. This 54-year-old woman died on Ebeye in 1990. When last seen by the Brookhaven team in October 1989 she was taking glyburide for diabetes mellitus and had a fasting glucose of 208 mg/dl and a HbA1c level of 7.4% (mildly elevated). A blood count was normal. Other problems considered earlier were bilateral cataracts, fibrocystic disease of breasts with negative mammogram in May 1989, negative Papanicolaou smear in 1988, and normal flexible sigmoidoscopy in 1987. The cause of death is unknown.

Laboratory Findings:

Hematology

A review of "blood counts" (average concentrations of formed blood elements) of the different exposure groups during the four-year reporting period does not reveal any systematic differences among groups. In 1989 and 1990 there was a significant increase in mean platelet count in Utirik exposed women as compared to the unexposed population (Table I). Figure 2 is a continuation graph in which hematologic data of the two exposed groups collected since 1956 are portrayed in relation to the expanded Comparison group. Table I gives the mean values (+/- SD) from which Fig. 2 is derived. The individual counts are given in Appendix B.

It is apparent from scanning the four graphs in Fig. 2 that there is a mild but relatively consistent depression, generally not statistically significant different, over most of the 37 post-exposure years, of neutrophil, lymphocyte, and platelet concentrations (the latter in males only) in the Rongelap/Ailingnae group. This depression appears to be of no clinical significance. These consistently slightly lower values for all three formed blood elements over such a long period in the Rongelap group suggests the possibility of radiation related mild impairment of hematopoiesis. However, there is no evidence of impaired leukocytosis in response to infection. Therefore, these differences may reflect a shift in cell compartmentalization (e.g. margination).

Hematologic changes in Japanese atomic bomb survivors have been recently reviewed (Finch and Finch, 1988). An early decline in leukocyte counts was detected from 1947 through 1956, but this occurred in both exposed and unexposed groups, and therefore was not an effect of radiation. Indeed, "no clearly established exposure differences have been uncovered except in the case of the leukemias" (Blaisdell and Amamoto, 1966). Therefore, a sustained depression in leukocyte counts, such as seen in the Rongelap group, was not detected among the exposed Japanese. With regard to leukocyte margination, no evidence of a radiation dose-effect in the exposed Japanese was apparent when exercise-induced leukocytosis was quantified (Belsky et al., 1972).

In general, radiation has been found to alter leukocyte function in humans only minimally, if at all, and, when dysfunction has been detected, it has been of no clinical importance. The most recent clinical study to confirm this was carried out on Japanese atomic bomb survivors and included phagocytic and bactericidal activities of neutrophils (Sasagawa et al., 1990).

It was noted that for ten years after the atomic bombings in Japan the leukocyte counts of persons followed by the Atomic Bomb Casualty Commission gradually decreased by about 35% in both the exposed and unexposed populations (Blaisdell and Amamoto, 1966). This trend was never completely explained, but the decline was chiefly attributable to a decrease in neutrophils. A slight trend in this direction can be detected in total leukocyte counts obtained on the Marshallese over a similar time span. Using data from the unexposed Comparison group, the mean total leukocyte concentration for 1954-1958 was 8,500/ul and for 1969-1974 it was 7,300/ul, a 14% decline. For 1985-1990 it has been 7,500/ul. A decrease in absolute lymphocyte concentration, approximately 1,000/ul, occurred simultaneously. This finding differs from that of the Japanese, in whom it was the neutrophils that were predominantly lowered. For the Marshallese, minimal fluctuation was seen in neutrophil count for the three periods. The reason for the apparent decrease in lymphocyte concentration in both exposed and unexposed Marshallese is unknown.

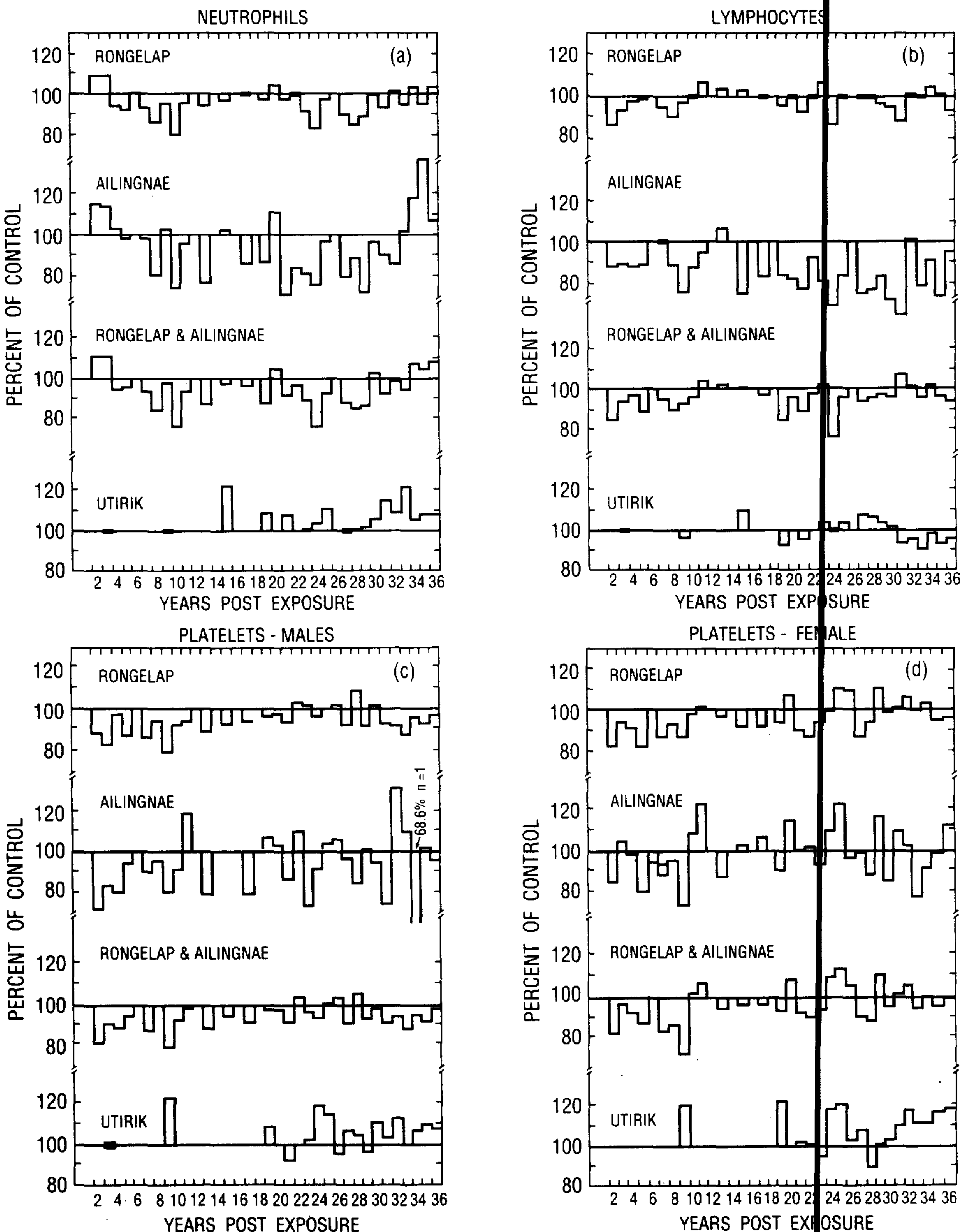

Fig. 2: Annual mean blood cell counts of the different exposure groups (age 5 years or more) expressed as percent of the unexposed Comparison group, beginning two years after exposure. Values for both sexes are grouped for neutrophils and lymphocytes. Detailed annual observations, including blood cell counts, on the Utirik population did not begin until 1973. Leukocyte differentials and platelet counts were not obtained for six and five of the examination years, respectively, but for graphing purposes the 100% line has not been broken at those years.

TABLE 1: Hematologic parameters (mean +/- SD) for the different exposure groups obtained at the time of annual examination for years 1988 through 1991.

	Comparison	Rongelap	Utirik
LEUKOCYTES			
1988	7991 ± 1946 (n=83)	8156 ± 1732 (n=50)	8055 ± 2264 (n=83)
1989	7511 ± 2085 (n=76)	7363 ± 2015 (n=49)	7806 ± 2237 (n=90)
1990	6762 ± 1616 (n=71)	6865 ± 1890 (n=52)	7093 ± 2128 (n=83)
1991	6815 ± 1724 (n=69)	6761 ± 1852 (n=49)	7115 ± 1894 (n=86)
NEUTROPHILS			
1988	4084 ± 1312	4310 ± 1304	4341 ± 1605
1989	3984 ± 1651	4133 ± 1616	4342 ± 1577
1990	3779 ± 1414	4032 ± 1742	4124 ± 1724
1991	3510 ± 1416	3599 ± 1426	4023 ± 1443
LYMPHOCYTES			
1988	2916 ± 1081	2993 ± 889	2875 ± 1047
1989	2587 ± 863	2534 ± 883	2463 ± 1108
1990	2370 ± 769	2235 ± 774	2305 ± 619
1991	2510 ± 803	2426 ± 972	2210 ± 668
MONOCYTES			
1988	343 ± 235	327 ± 200	321 ± 208
1989	335 ± 196	316 ± 198	398 ± 239
1990	315 ± 180	297 ± 201	350 ± 213
1991	281 ± 160	306 ± 213	333 ± 200
EOSINOPHILS			
1988	490 ± 519	327 ± 200	459 ± 807
1989	438 ± 422	415 ± 484	370 ± 467
1990	248 ± 228	315 ± 394	285 ± 228
1991	442 ± 467	396 ± 333	448 ± 372
BASOPHILS			
1988	54 ± 70	41 ± 87	46 ± 77
1989	47 ± 69	45 ± 60	56 ± 68
1990	41 ± 58	45 ± 72	45 ± 59
1991	64 ± 70	42 ± 54	54 ± 69
PLATELETS, MEN			
1988	277 ± 74(n=35)	266 ± 57(n=18)	296 ± 67(n=[illegible]9)
1989	292 ± 71(n=30)	275 ± 55(n=20)	322 ± 64(n=[illegible]1)
1990	243 ± 46(n=33)	239 ± 56(n=23)	264 ± 45(n=[illegible]7)
1991	251 ± 63(n=29)	235 ± 51(n=21)	284 ± 57(n=[illegible]6)

(continued)

TABLE 1 (cont'd)

PLATELETS, WOMEN			
1988	318 ± 84(n=47)	319 ± 87(n=28)	356 ± 100(n=44)
1989	312 ± 68(n=45)	300 ± 71(n=28)	352 ± 83(n=47)*
1990	272 ± 44(n=44)	272 ± 55(n=29)	322 ± 58(n=46)*
1991	280 ± 55(n=39)	296 ± 71(n=27)	336 ± 79(n=46)
HEMOGLOBIN, MEN			
1988	15.1 ± 1.2	14.6 ± 1.1	15.1 ± 1.2
1989	14.7 ± 1.6	14.3 ± 1.3	15.3 ± 1.4
1990	14.8 ± 1.5	14.0 ± 1.4	15.4 ± 1.4
1991	14.9 ± 1.3	14.3 ± 1.3	15.4 ± 1.6
HEMOGLOBIN, WOMEN			
1988	13.4 ± 1.0	13.2 ± 1.0	12.9 ± 1.3
1989	13.4 ± 1.0	13.3 ± 0.9	13.0 ± 1.3
1990	13.2 ± 1.0	13.1 ± 1.1	12.9 ± 1.3
1991	13.0 ± 1.0	12.8 ± 1.4	12.8 ± 1.2

* Significantly different ($p < 0.05$) from the Comparison Group

Hypothyroidism:

Thyroid hypofunction, either clinical or biochemical, has been documented as a consequence of radiation exposure in fourteen Rongelap individuals (Larsen et al., 1982). In 1983 another exposed person was diagnosed as being biochemically hypothyroid based on results of routine thyroid function testing (Adams et al., 1988). The patient was an asymptomatic 34-year-old man who had no abnormality on physical examination of the thyroid. Treatment with synthroid was started in 1984. This represented the first case of spontaneous hypothyroidism diagnosed in the Utirik population. He was 1 year of age at the time of exposure, and, being from Utirik, no thyroxine suppression had been subsequently prescribed. An estimate of his total thyroid radiation dose was 561 cGy (internal = 550 cGy; external = 11 cGy). Clinical follow-up of this patient since 1987 has revealed the following. At the patient's request thyroid function tests were repeated by physicians of the Health Services of the Marshall Islands while he presumably was not taking thyroxine. However, we do not know the assay methodology or whether the patient in fact, discontinued his thyroxine. The results were found to be normal. The conclusion of those physicians was that he was euthyroid and that the decrease in thyroid function noted by the Brookhaven medical program represented self-limited hypothyroidism due to thyroiditis. However, there was no evidence of a preceding hyperthyroid state.

Furthermore, his thyroid function studies over the years were:

	Thyroxine	TSH*
1973	4.8	
1977	3.7	3.7
1979	6.3	7.3
1980		5.4
1981	4.7	3.8
1983	4.7	11.4
1984		3.3
1985		7.5
1986	5.8	4.2
1987		2.1
	Thyroxine	TSH*
1988	3.7	6.2
1989		3.3
1990		3.0
1991	0.6	4.2

*Normal ranges: Total thyroxine - 4.5-12.5 ug/ml; Thyroid stimulating hormone (TSH) - 0.43-3.8 uIU/ml.

Thus, this patient's thyroid function tests have been on the low side of normal and occasionally overtly low for many years. Transient hypothyroidism persisting for many years has been reported with chronic autoimmune thyroiditis (Takasu et al., 1992). However, the Utirik patient had no detectable antithyroglobulin or antimicrosomal antibodies. While the role of radiation exposure in producing this patient's illness is not certain, an argument can be made for relating the two. Further observation may document the true nature of the thyroid hormone fluctuations in this patient. Since an increase in risk of hypothyroidism might be attributed to radiation exposures as low as 20 cGy (Maxon et al., 1977), the patient clearly was at risk for developing the disorder.

Other laboratory results:

Appendix B also includes results of other tests that are performed on many or all of the exposed persons. Several of these tests have been used to screen for occult malignant disease. Although there is no general marker for malignancy, the clinical justification for, and the results of, those tests are described here.

Serum protein electrophoresis

Multiple myeloma is one of the hematological malignancies that has been determined to be inducible by radiation (Cuzick, 1981). This interpretation is strengthened by findings in Japanese atomic bomb survivors, although the effect of radiation was not detectable until about 20 years after exposure (Ichimaru et al., 1982). The production of a monoclonal protein detectable by serum electrophoresis often precedes by years the other clinical manifestations of multiple myeloma. Although the risk of myeloma is small, serum protein electrophoresis is performed on the exposed Marshallese about every three years in order to detect the early appearance of a monoclonal protein. If a monoclonal spike were to be found in a patient's serum, it would not necessarily indicate the presence of myeloma. Conversely, the absence of such a spike does not rule out myeloma. Nevertheless, it is used as a screening test, and no monoclonal proteins were detected during the 1989 serum testing of the Marshallese sera.

In common with many populations in tropical regions, the Marshallese have relatively high globulin levels. This increase is polyclonal, and the cause is unknown.

Serum calcium

An endocrinological disorder that has been thought to be associated with both external and internal ^{131}I radiation is hyperparathyroidism (Cohen, et al., 1990; Rosen et al., 1984). A dose-dependent increase in the incidence of hyperparathyroidism has also been reported in Japanese atomic bomb survivors (Fujiwara et al., 1990). In all three cited studies, parathyroid adenomas were present in most patients. Some of the exposed Marshallese received large radiation doses to the parathyroid gland, as well as high external doses. Furthermore, the susceptibility of Marshallese to this effect of radiation is unknown. Therefore, serum calcium levels are checked every three years. No elevated levels were detected during the 1989 survey.

Serum alpha-fetoprotein

There is a high risk of hepatocellular carcinoma in persons who remain persistently positive for hepatitis B surface antigen. The last Brookhaven medical program report discussed this disease in relation to the exposed Marshallese, for the prevalence of serologic evidence of hepatitis B infection in the Marshall Islands is very high (Adams et al., 1986). In some instances it is possible to identify hepatocellular carcinoma at an early stage by testing serum for alpha-fetoprotein. This might permit identification of the tumor at a stage when it is still resectable. Therefore, all exposed and unexposed persons who are known to the medical program to be seropositive for hepatitis B surface antigen have alpha-fetoprotein levels performed annually.

Erythrocyte macrocytosis

The many causes of macrocytosis include several premalignant and malignant hematologic diseases. Therefore, erythrocyte size is checked annually. During the four years covered by this report no unexplained or irreversible macrocytosis was detected in the exposed population. Those elevated levels that were found appear to have been due to nutritional deficiencies (either folic acid or vitamin B12) or chronically excessive ingestion of alcohol.

Serum prolactin

Two pituitary tumors have been identified in the exposed Marshallese (Adams et al., 1984). Because other exposed persons might develop these benign neoplastic lesions, prolactin levels are performed every two years. Although serum prolactin elevation is not found in all pituitary tumors, it is by far the most common hormonal abnormality and therefore is used as the screening test for the exposed population. No new or unexplained elevations were detected for the present reporting period, but one elderly Utirik woman still has the slightly elevated level mentioned in a previous Brookhaven report (Adams et al., 1985). A CT scan of the patient's sella turcica in 1990 revealed no tumor.

Neoplasms:

Skin cancers

One basal cell carcinoma of the face was diagnosed in an exposed Rongelap woman in 1986 (Adams et al., 1988). A second person, also in the Rongelap exposed group, had a basal cell carcinoma removed in 1991. The development of two skin cancers some thirty years post-exposure in a population not considered susceptible to such lesions raises the possibility that there is some relation to their 1954 beta radiation exposure. The specific clinical situations are described below.

Subject No. 1. This 56-year-old Rongelap man was 18 years of age at the time of his exposure to fallout from BRAVO. He washed off the debris within several hours after the fallout ceased. He sustained first-degree burns to his right antecubital fossa and both feet. These became apparent several weeks after exposure and lasted for several weeks. He also experienced typical nail discoloration. One year later on reexamination healing was complete. Subsequent skin examinations were unremarkable until April 1991 when a 1.5 cm lesion with a necrotic center was noted on his left scapula. An excisional biopsy was performed and the final pathological diagnosis was basal cell carcinoma. The tumor extended to all lines of excision. Therefore, definitive treatment consisted of a reexcision a few months later. Subsequent examinations have revealed no evidence of recurrence.

Subject No. 2. This 70-year-old Rongelap woman was 38 years of age at the time of exposure. She was felt to be one of two patients most heavily exposed to external beta radiation. She did not wash off the fallout debris for a full 24 hours. Within a few days skin lesions developed. The burns, most first degree, eventually included the neck, neckline, left hand and wrist, left cheek, forehead, thorax and groin, lasting another few weeks. There was some hair loss. One year later the skin had essentially healed, except that there was persistent beta-burn scarring on the left side of the neck noted up to 1960. Followup skin examinations were benign until April 1986 when two skin lesions were noted: a 4 mm papule in the right supraorbital area and a 7 mm nodule anterior to the right ear. Excisional biopsies revealed both to be basal cell carcinomas. Reexamination up to 1992 has revealed no evidence of recurrence.

Skin cancer in dark-skinned races has generally been considered to be rare. Studies in a black population suggest that skin cancer occurs at the site of old burns or other scars, chronic ulceration and infection (Oettlé, A.G.; Databo-Brown, D.D.; and Fleming I.D. et al.). These cancers are usually squamous cell carcinomas and are invasive and aggressive (Amonette, R.A. and Kaplan, K.J., and Fleming I.D. et al.). Basal cell carcinomas, when they do occur, are located in sun-exposed areas, as they are in Caucasians. That there is a relative increase in incidence of skin cancer in black albinos or those of mixed race when compared to pure Blacks (Oettlé, A.G. and Burns, J.E.) suggests that melanin is a protective factor. Other ethnic groups have not been extensively studied.

Ionizing radiation from sources other than sunlight is also known to be a risk factor in the induction of skin cancer (Davis, M.M., et al; Walther, R.R. et al.; and Myskowski, P.L. et al.). Studies of children irradiated for ringworm (Shore, R.E., et al.; and Ron, E., et al.) and other patients irradiated for a variety of conditions (Davis, M. et al.; Walther, R. et al.; and Myskowski, P. et al.) show that radiation is associated with an increased incidence of skin cancer, mostly basal cell tumors, and generally occurring among Caucasians, but occasionally in Blacks.

The skin cancer in the Rongelap woman (#2) occurred in an area that was both sun-exposed and previously injured by beta radiation. For the Rongelap man (#1) neither sun nor beta radiation would have been expected to converge on the subscapular area (unless he had been customarily shirtless). However, two persons developing skin cancer out of a radiation-exposed population of 82 (2.5%) is greater than expected if Black population studies are used for comparison (Fleming, I.D. et al.). Furthermore, there is a suggestion of a temporal association, for the cancers occurred 32 and 37 years after exposure. Therefore, the possibility remains that radiation exposure did contribute in a direct or indirect way to the development of basal cell carcinomas in these two patients.

Thyroid nodules

Only one thyroid nodule was diagnosed in the exposed population from January 1988 through December 1991. That nodule occurred in a Utirik man who had been in utero at the time of exposure in 1954. The mother was in her third trimester at the time of exposure, her whole-body and thyroid-absorbed doses being estimated at 11 and 160 cGy, respectively. The patient's estimated dose was, therefore, 11 cGy whole-body and 99 cGy internally to the thyroid, for a total thyroid dose of 110 cGy. This patient is the first of eight Utirik persons exposed in utero to develop a thyroid nodule. (Two of four Rongelap persons who were in utero at the time of exposure have also had benign nodules removed). A thyroid lobectomy was performed at the Clinical Center, The National Institutes of Health. Histological review of the surgical material was performed by the four pathology consultants to the Marshall Islands Medical Program (see p. 16). Selected comments from their diagnoses are:

Consultant #1 - "Thyroid nodule of histologically normal tissue which contains a tiny focus of occult papillary carcinoma."

Consultant #2 - "Adenomatous goiter in the colloid stage."

Consultant #3 - "Nodule with fibrosis.... No evidence of cancer."

Consultant #4 - "Tiny occult sclerosing papillary carcinoma."

A summary of this patient's hospital case is included in Appendix C. The patient was returned home on thyroxine suppression.

Table 2 summarizes the thyroid nodule findings in the exposed Marshallese through 1991. It includes the nodule described in the preceding paragraph, which is listed under the heading of "Occult Papillary Carcinoma." The number and types of nodules in the Comparison group are also listed in Table 2, although the U.S. Department of Energy-sponsored program for surgical exploration of palpated nodules in this group was concluded in 1985.

THYROID SURGERY FINDINGS, 1964 THROUGH 1991

Introduction:

Thyroid nodules and hypofunction among the exposed populations of Rongelap and, to a lesser extent, Utirik are well documented consequences of the BRAVO exposure. A recent reevaluation of external and internal radiation exposures in those populations in all likelihood represents the definitive quantitative analysis of organ and whole-body radiation dose stemming from this catastrophe (Lessard et al., 1985). The thyroid dose received particularly close scrutiny because of early evidence of extensive thyroid injury and because an important mechanism of exposure was ingestion of a variety of radioiodines, an occurrence without precedent and therefore with unknown consequences.

A final interpretation of the effect of fallout exposure on the thyroids of the exposed Marshallese has not been possible because of the protracted evolution of thyroid abnormalities following radiation exposure. The incidence of thyroid cancer has been reported to be elevated more than 40 years after radiation exposure (Shore et al., 1985; Schneider et al., 1978) and might include a lifetime at risk. However, for the past six years (1986 through 1991) only one new thyroid nodule (nonmalignant) has been detected in the exposed persons. Furthermore, there has been only one new nodule diagnosed in the Rongelap group in the past ten years. (There have been two thyroid surgeries for recurrent benign nodules in the Rongelap group, but these are not included in the statistics that follow). Although occasional nodules will no doubt continue to be diagnosed, if for no other reason than that thyroid nodule prevalence increases naturally with aging, it is possible that the recent dearth of cases represents a pause that is

TABLE 2: Thyroid Nodules Diagnosed at Surgery through 1991

	Adenomatous nodules	Adenomas	Papillary cancers	Follicular cancers	Occult cancers
Rongelap (67)[a]	18	1	5	-	-
Ailingnae (19)	4	1	-	-	1
Utirik (167)	10	5	4	1[c]	6
Comparison (277)[b]	4	1	2	-	2[d]

NOT INCLUDED are the following unoperated (and therefore unconfirmed) nodules: Rongelap --1: Ailingnae -- 1: Utirik -- 1: Comparison -- 5.

INCLUDED are all consensus diagnoses of a panel of consultant pathologists: two different lesions were detected in one person from Rongelap, one from Ailingnae, and two from Utirik.

a Number of persons (including those in utero) who were originally exposed.

b This number includes all persons who have been in the Comparison group since 1957. Some have not been seen for many years; others were added as recently as 1976. No thyroid surgeries have been performed on this group since 1985.

c Equally divided opinion in one case; follicular carcinoma vs. atypical adenoma.

d. Majority opinion in one case; occult papillary carcinoma vs. follicular carcinoma. The same patient had lymphocytic thyroiditis.

characteristic of the type of thyroid injury sustained by the Marshallese. Two alternative explanations are 1) the "epidemic" of thyroid nodule formation is virtually over, and 2) the recent decrease in nodule incidence is due to random fluctuation and therefore temporary. Although time may tell which of the above explanations is correct, the respite in new cases provides an opportunity to bring together information on thyroid nodules collected by the Marshall Islands Medical Program over almost three decades and to draw tentative conclusions on several issues that may be relevant to inadvertent radiation exposures elsewhere.

Radiation risks to the thyroid:

One aspect of radiation-induced thyroid injury that has been repeatedly assessed is the dose of radiation required to induce it. Data available from the Marshall Islands Medical Program have been recently summarized (Robbins and Adams, 1988), with the following conclusions:

1) The risk coefficient for thyroid nodules, adjusted for their occurrence in the Comparison population, was 8.3 per 10^6 persons, per cGy, per year.

2) The risk coefficient for thyroid cancer was 1.5 per 10^6 persons, per cGy, per year.

3) The contribution of ^{131}I to the thyroid absorbed dose was relatively small, in the range of 10-15%, the remainder being due to short-lived radioiodines. Perhaps as a consequence, the radiation-induced risk for developing nodular disease in the exposed Marshallese appears similar to that predicted if the total thyroid dose had been from external irradiation alone.

Since the above analysis included all the nodules up to the present, and since the Marshallese thyroid dose data have provided no insight into radiation-induced risk of thyroid carcinoma that was not already available from other sources, no further comment on dose-response and risk of thyroid disease will be made in this summary.

Histologic definitions:

In interpreting the Brookhaven medical program data on thyroid nodules the histopathological classification of thyroid nodules used by the expert panel of pathologists needs to be reviewed. This classification, based on diagnostic categories recommended by the World Health Organization (Hedinger and Sobin, 1974) and modified in 1981 by Dr. Donald Paglia of the Department of Surgical Pathology, University of California, Los Angeles, for the panel's use, has been applied to all thyroid specimens obtained at surgery since the beginning of the program:

Adenomatous nodule: a focal proliferative lesion consisting of changes typical of adenomatous goiter; the lesions are hyperplastic and do not fulfill criteria of true neoplasms.

Adenoma: an encapsulated proliferative lesion with a uniform internal growth pattern and benign clinical course.

Occult papillary carcinoma: a small nonencapsulated sclerosing carcinoma; considered to be clinically benign even if associated with positive regional lymph nodes.

Papillary carcinoma: larger, infiltrating carcinoma, usually containing both papillary and follicular components.

The four pathologists on the panel that review the Marshallese specimens are: Dr. L.V. Ackerman, Health Sciences Center, SUNY, Stony Brook, NY; Dr. W.A. Meissner, formerly with New England Deaconess Hospital, Boston, MA; Dr. A.L. Vickery, Massachusetts General Hospital, Boston, MA; Dr. L.B. Woolner, Mayo Clinic, Rochester MN. Histologic sections of all surgically removed thyroid tissue have been examined by these authorities. Although most diagnoses have been unanimous, some were controversial. In the following analysis and discussion of Marshallese nodules, the "most neoplastic" diagnosis has been selected when there has been a split decision, with the "least neoplastic" being the adenomatous nodule, next being the adenoma, the third being occult papillary cancer, and the most neoplastic being the carcinoma.

Appendix D lists all exposed persons who have had thyroid surgery which confirmed a thyroid lesion.

Thyroid nodules in the Comparison group

The examination of the Comparison group has been invaluable in interpreting the thyroid nodule risk data among the exposed population. Even though they do not constitute an ideal "control" group, it is not likely that a better comparison population could have been obtained without initiating a formal, prospective research effort. It is appropriate that the voluntary cooperation of the members of this group be gratefully acknowledged by all who have relied on the Marshallese thyroid nodule data to interpret the role of radiation in causing thyroid disease. In that the unexposed Comparison group comprises persons of Rongelap ancestry and was quite closely age- and gender-matched when selected in 1957, this group is more representative of the exposed Rongelap population than any other Marshallese community and certainly more so than a population of non-Marshallese.

The development of thyroid nodules in the Comparison population is similar to the spontaneous thyroid nodule incidence reported elsewhere. Maxon et al. (1977) concluded that the rate of development of benign thyroid nodules and thyroid carcinomas in western countries is 0.07% and 0.01% of the population per year, respectively, and that the incidence is linear with respect to age. In 1990 the number of person-years of observation of the Comparison group was 10,400. Therefore, based on the conclusions of Maxon et al. (1977), the expected number of thyroid nodules, benign and malignant, would be 8.3, of which 6 or 7 would be benign and 1 or 2 would be carcinomas.* In fact, 8 nodular thyroids were detected, of which 6 were benign and 2 were carcinomas (see Table 2). Possible sources of inaccuracy include the following: (1) Only surgically confirmed nodules are included. Therefore, since several unoperated nodules have been diagnosed in the Comparison group, the "observed" number may underestimate the true number of thyroid nodules. However, the palpated nodules may have been lipomas or neuromas, for example, and therefore appropriately excluded. (2) One of the two occult papillary carcinomas diagnosed in this group was not detected prior to surgery. This "nodule" is therefore excluded. Thus the total number of nodules is given as 8 rather than 9, as listed in Table 2. (3) 1984 is the latest year of observation for the purpose of this calculation because thyroid surgery for the Comparison group was not offered after 1985.

*In this calculation, to obtain the number of person-years of observation the individual ages at the time of the most recent examination were summed, with the exclusion of all years subsequent to thyroid nodule surgery in those cases where it was performed. To use an extreme example, if a 60 year-old person was first enrolled in the Comparison group and examined in 1975 and subsequently never appeared for reexamination, 60 person-years of observation was calculated. The justification for this approach is that it is considered unlikely that any clinically apparent thyroid nodule will spontaneously disappear. In a recent follow-up study of children among whom some nodules had been detected approximately fifteen years previously, only 10 percent of the nodules were no longer palpable (Rallison et al., 1991).

Factors influencing data interpretation:

It is possible to draw tentative conclusions relevant to issues of radiation injury to the thyroid from data available on the exposed populations alone, thereby avoiding assumptions about the adequacy of a control group. The data underlying the following analyses are shown in Appendix D and grouped and tabulated in Table 3. However, interpretation of the Marshallese thyroid nodule data must be done cautiously because of the small number of observations that were possible. This is particularly true when the nodules are subgrouped and analyzed by histologic type. In addition, thyroid disease is greatly influenced by gender, thereby further decreasing sample size for some analyses, particularly in males. Another confounding factor, thyroxine suppression, was initiated in 1965 in an attempt to inhibit or prevent the growth of benign and malignant thyroid nodules. This was prescribed only for the exposed Rongelap population, for the risk of nodule development resulting from the much lower Utirik exposure was felt to be small at that time. It therefore becomes difficult in some instances to interpret results in which Rongelap and Utirik data are grouped together. Finally, just why there were no nodules detected during the first nine years of medical team visits (1955-1963) is not clear. Based on the estimate of nodule incidence of Maxon et al. (1977) two nodules would have been expected to develop in the Rongelap group by 1963. It is possible, therefore, that the absence of nodules in the early years was merely a consequence of random distribution of a relatively uncommon abnormality, particularly since the mean age of the Rongelap people at the time of exposure was rather low, 27.6 years. Once the first nodules were detected in 1963 it became the procedure of the Marshall Islands Medical Program to include in its medical team a person highly skilled in thyroid examination, usually an endocrinologist with special expertise in thyroid disease or a thyroid surgeon. This change in procedure introduces a possible bias that is impossible to quantitate.

It is possible that some nodules in the exposed population were naturally occurring rather than radiation-induced. However, as there is no way to identify which nodules these were, no attempt has been made to correct for their presence.

Issues that can be addressed without invoking data from the Comparison group:

1) Is the "epidemic" of thyroid nodules over?

The number of patients undergoing thyroid surgery by year over the duration of the Marshall Islands Medical Program is shown in Fig. 3a. The same data are shown in Fig. 3b except that cases are expressed as percent of the population that remained susceptible to new nodule formation; i.e., excluding persons with prior nodules and persons who had died prior to the year for which a percent was calculated. Clearly the incidence of nodules which began in the mid-1960's in the exposed Rongelap group has greatly, if not completely, subsided. Their detection spanned 22 years, beginning 9 years after exposure. The nodules in the Utirik group, on the other hand had a later onset and a later apparent decline. Detection of Utirik nodules has spanned 19 years, beginning 15 years after exposure.

In the following discussion the total thyroid absorbed dose in Figures 4-7 represents the acute radiation dose to the thyroid occurring during exposure to fallout prior to evacuation and time to development of nodules (years post exposure) refers to the interval in years from exposure to the initial clinical detection of the nodule.

Possibly more appropriate questions to ask are, (1) is the epidemic of adenomatous (nonneoplastic) nodules over, and (2) is the epidemic of neoplastic

Table 3: Major thyroid nodules types*, total (internal and external) mean thyroid-absorbed dose, and time from exposure (1954) to time of surgery, grouped by age.**

Column	A	B	C	D	E
	Type of Nodule (n)	**Ratio Benign Cancer**	**Percent of (n)**	**Total Thyroid Dose +/-SD**	**Years to Surgery +/-SD**
Rong <10 yr (n=26)	Benign (16)***	16:1	62	3289+/-1323	14+/-4
	Cancer (1)		4	2490	15
	Adenomatous (16) nodules		62	3289+/-1323	14+/-4
Rong >10 yr (n=54)	Benign (5)	1.25:1	9	856+/-649	19+/-5
	Cancer (4)		7	1415+/-150	20+/-9
	Adenomatous (4) nodules		7	970+/-689	19+/-5
Utirik <10 yr (n=57)	Benign (7)	3.5:1	12	509+/-137	28+/-3
	Cancer (2)		4	526	26
	Adenomatous (3) nodules		5	478+/-178	28+/-3
Utirik >10 yr (n=102)	Benign (12)	4.0:1	11	198+/-41	24+/-4
	Cancer (3)		3	168+/-6	22+/-8
	Adenomatous (7) nodules		7	171+/-0	23+/-8

* If two thyroid nodules occurred in the same individual only the "higher grade" nodule was counted.

** Ten years of age is used as cut-off for the younger group because Rongelap children below this age received a mean thyroid-absorbed dose of >2000 cGy and thereby sustained extensive thyroid injury, a factor that influenced nodule type. All others received lower doses. Two in Utero Rongelap children who received <2000 cGy are not included in the table.

*** "Benign" nodules include adenomatous nodules, adenomas, and occult papillary carcinomas.

nodules over? Inspection of Fig. 4a shows that the answer to (1) is in the affirmative, at least for the Rongelap people. No adenomatous nodule has been found at surgery for 12 years. The detection of adenomatous nodules spanned 15 years beginning 9 years after exposure. For the Utirik group, detection spanned 12 years, beginning 19 years after exposure.

For question (2), the answer is less clear. Although only 1 neoplastic nodule (a carcinoma) has been diagnosed in the past 10 years in the Rongelap population, several have been found in the Utirik group during the same period (Fig. 4b).

A striking observation is the virtually identical percent of neoplastic lesions that have occurred over thirty-six years of observation in the two exposed groups, being 8 individuals for the 86 Rongelap persons (9.3%) and 15 individuals for the 167 Utirik persons (9.0%). Given the great differences between the two groups in total-body and thyroid-absorbed radiation doses, it is clear that (1) other factors, such as the possibility of thyroid cell killing

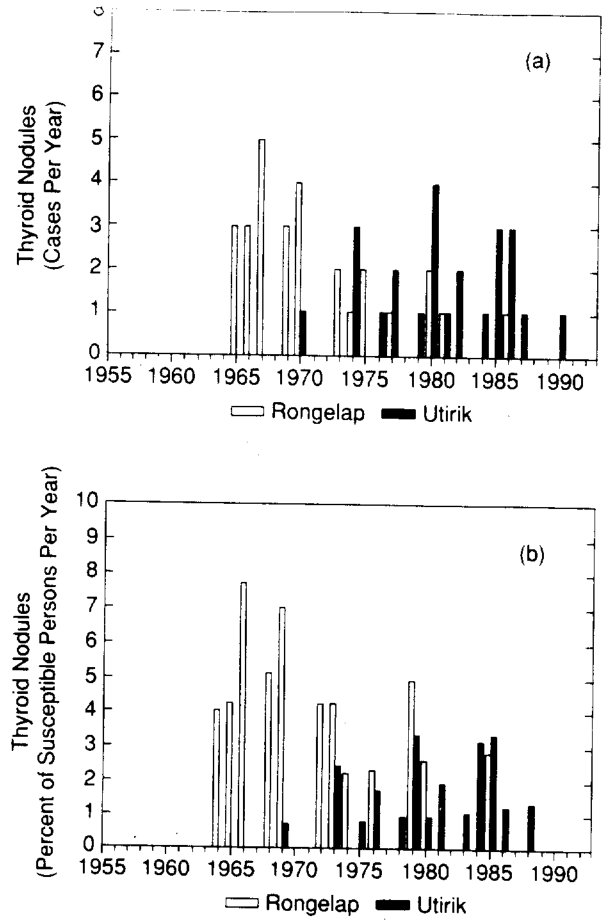

Fig. 3: Surgically confirmed thyroid nodules, Rongelap and Utirik exposed population. (a) Surgical cases per year; (b) surgical cases per year expressed as percent of the remaining susceptible population. (remaining individuals at risk to develop their first nodule).

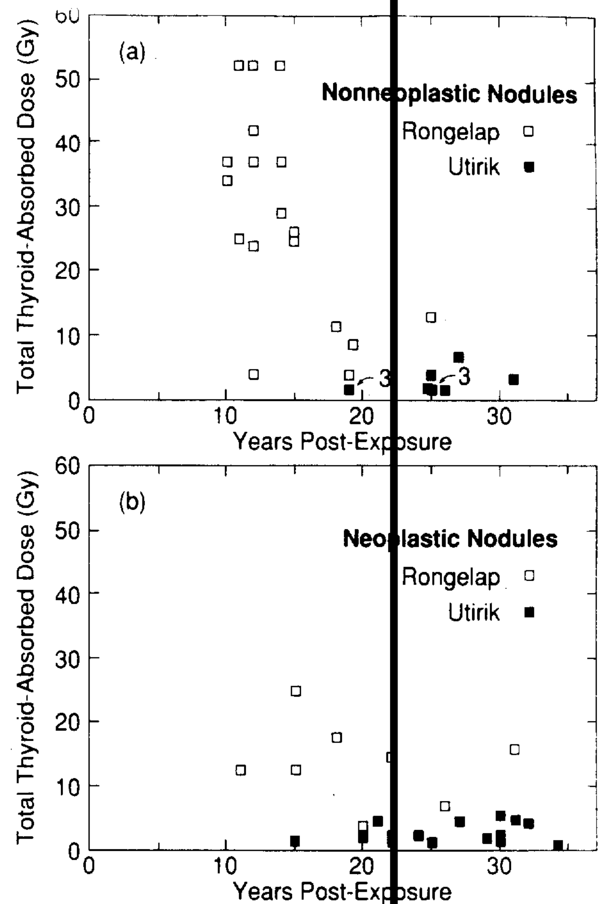

Fig. 4: Relation of thyroid-absorbed dose to time of development of (a) non-neoplastic nodules (adenomatous nodules) and (b) neoplastic nodules (adenomas, occult papillary carcinomas, and overt thyroid carcinomas.)

at high doses, may have had a great effect of the ultimate type of nodule that develops, or (2) lumping of adenomas, occult papillary carcinomas, and overt carcinomas in one "neoplastic" category is not valid for this type of analysis. Probably both explanations are correct to some extent. It may be that high and low doses of radiation to the thyroid are equally neoplastigenic but not carcinogenic.

2) What was the role of gender in nodule development:

The distribution of various nodule types by gender (Table 4) shows a female preponderance for all categories of nodules. This is to be expected in all but the occult papillary carcinomas. Published data indicate that in the latter both genders are affected about equally, although sometimes there is a male preponderance (Woolner et al., 1960; Harach et al., 1985; Sampson et al., 1971).

The relation of radiation dose to time of development of all nodules is identical for males and females (Fig. 5).

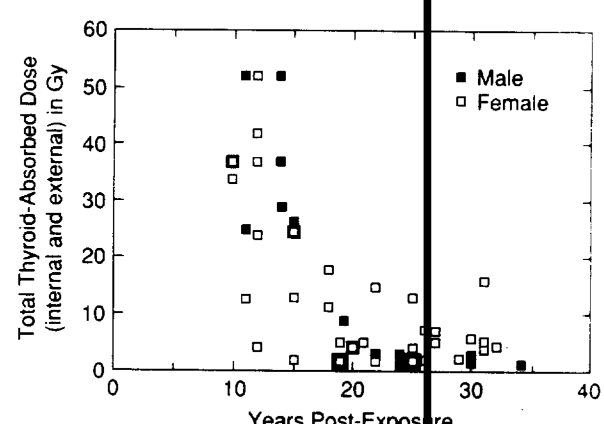

Fig. 5: Relation of thyroid-absorbed dose to time of development of surgically confirmed nodules, according to gender.

TABLE 4: Distribution of thyroid nodule type by gender.

	Male (%)	Female (%)	Total
Adenomatous nodules	8 (25)	24 (75)	32
Adenomas	2 (29)	5 (71)	7
Occult papillary carcinomas	2 (29)	5 (71)	7
Carcinomas	1 (10)	9 (90)	10
Total	13 (23)	43 (77)	56*

* The total number of nodules exceeds the number of surgeries because four patients had two categories of nodules.

3) What was the relation of radiation dose to time of nodule detection?

The strong correlation between higher dose and earlier nodule development is shown in Fig. 5. While this graph gives an overview of the epidemic in relation to dose, it offers little understanding of the role of the variables that shaped it.

The predominant nodule type was the adenomatous nodule, the ratio of these to all other types being 4:3. Adenomatous nodules are not neoplastic. Therefore, Fig. 5 predominantly describes the relation of radiation dose to non-neoplastic nodular disease. Secondly, the prominent association of higher radiation dose with early nodule development is influenced by age-related variability in susceptibility to thyroid cancer (NRC BEIR V, 1990) and benign tumors (Ron et al., 1989; Shore et al., 1985). The mean age of the Rongelap people at the time of exposure was 27.6 years, but the range of ages was 0 (there were 4 persons in utero) to >80 years, and susceptibility would have varied accordingly.

Inferences concerning dose and time to development of adenomatous nodules can be extracted from data on persons exposed at equivalent ages, thereby controlling for susceptibility. In Figure 6 the time to development of nodules is graphed against dose in children one to six years of age. Three of these children were on Utirik (ages: 1, 5, and 5 years). The correlation between dose and time to development of adenomatous nodules was highly significant ($r = -0.848$; $p < 0.001$). Although the number of observations is small, these data suggest that the earlier development of adenomatous nodules was primarily a function of higher radiation dose to the thyroid, not age. One variable which is not controlled for is thyroxine prophylaxis for the Rongelap children. Prophylaxis was not initiated until ten years after exposure and after the first nodules had been detected. Therefore, the effect of thyroid suppression on development of thyroid nodules was not of consideration for the first 10 years after exposure. In addition almost all adenomatous nodules in this group had been identified within five years of initiation of thyroxine suppression.

A similar age-controlled analysis for the other three nodule types is not useful because there are too few observations per group.

4) What was the relation between nodule development and age at exposure?

The relation of nodule type to dose and age at exposure is shown in Fig. 7a-d. The graphs indicate a similarity in the age- and dose-related development of all four nodule types in the Utirik group. Only adenomas (Fig. 7b) did not develop in persons exposed beyond their teenage years.

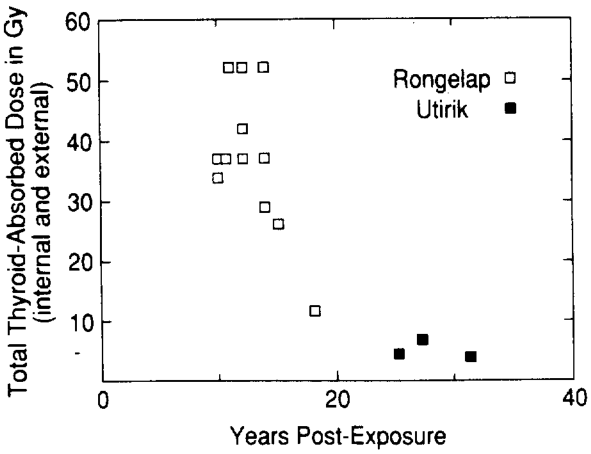

Fig. 6: Relation of thyroid-absorbed dose to time of development of surgically conformed nodules in persons who were between 1 and 6 years of age at the time of exposure on Rongelap and Utirik.

However, there is a marked disparity among the four graphs for the Rongelap group. The occurrence of many adenomatous nodules in the younger Rongelap population (Fig. 7a) could have been a function of either age or high radiation dose, because the thyroid-absorbed dose was strongly age-dependent. However, none of the other three nodule types in the Rongelap exposed group (Fig. 7b-d) show the same preference for younger ages, although the number of observations is quite small. It is possible that the development of adenomas and occult papillary carcinomas, as well as overt carcinomas, was limited by thyroid cell injury resulting from the high radiation dose to the young Rongelap population. It is ironic that neoplastic nodules in the Rongelap group were numerically overshadowed by benign nonneoplastic lesions. While one might consider this to be, in a sense, a mitigation of radiation injury, the significant morbidity of benign thyroid nodules in the exposed Marshallese has been discussed (Adams et al., 1988).

5) Did benign nodules antedate carcinomas?

A highly significant correlation for time of development of benign nodules (either total benign nodules or adenomatous nodules) and thyroid cancers was found using mean time to surgery for the specified groups (Table 3, column E; r = 0.99 and p = <0.01). This striking similarity, which is present regardless of age or the use of thyroxine suppression, supports the notion that a benign lesion does not evolve into a malignant one, nor do carcinomas, presumably possessing a greater degree of autonomous growth, manifest themselves clinically any earlier than benign nodules. Ron et al. (1989) also noted a similarity in time from radiation exposure to tumor diagnosis for carcinomas, adenomas, and "nodules."

6) Was the type of thyroid nodule induced by radiation a function of dose?

It is thought that at thyroid doses above 1500-2000 cGy the incidence of carcinoma is decreased due to extensive cell death which leaves few cells capable of becoming neoplastic (NCRP, 1985), although there are reports of undiminished risk of thyroid cancer from external irradiation with thyroid doses exceeding 3000 cGy (Tucker et al., 1991). For palpable solitary nodules in the general population the usual ratio of benign to malignant lesions is about 6:1 and in some radiation-exposed groups it can be as high as 3:1 (DeGroot et al., 1983), although the ratio varies considerably depending on the definitions used. The ratios for the Marshallese are shown in Table 3, column B. In the Utirik group where the total thyroid dose was relative small the ratios for persons under 10 years of age is 3.5:1 and for those who were older it is 3.7:1. The high benign to malignant tumor ratio of 16:1 for Rongelap children who were exposed under the age of ten years and whose thyroid doses exceeded 2000 cGy is consistent with most other studies, and the likely explanation is a decrease in thyroid cancer due to extensive cell death or injury at the time of exposure.

What may also be important, however, is the low benign to malignant tumor ratio (1.25:1) found in those Rongelap individuals with mid-range thyroid radiation doses (i.e., Rongelap individuals over the age of 10 years at exposure, who received 400 to 2000 cGy). Thus, there was a high probability in this group of a detected nodule being malignant, whereas there was a relatively low probability of malignancy in persons whose dose exceeded 2000 cGy. This may be relevant in clinical decision-making for nodules detected in other exposed populations.

These findings indicate that up to a point, perhaps in the range of 1500-2000 cGy, the greater the radiation dose the greater is the chance of a detected thyroid nodule being cancerous.

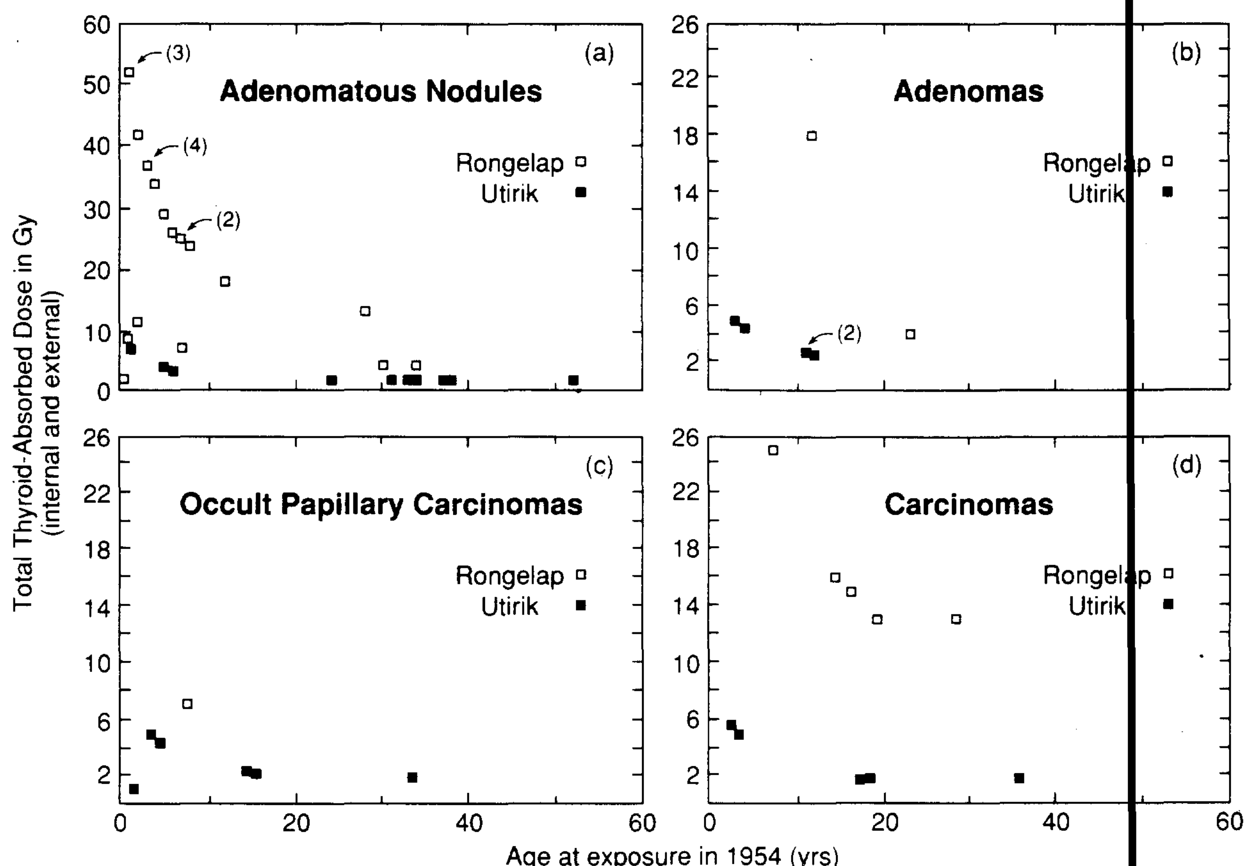

Fig. 7: Relation of thyroid-absorbed dose to age at exposure categorized by nodule histology.

7) Did radiation increase the incidence of "occult" carcinomas?

Occult thyroid carcinomas have been found in 6-36% of routine autopsies in many parts of the world (Fukunaga and Yatani, 1975; Harach et al., 1984), and the prevalence does not increase with age, in contrast to overt carcinomas and benign lesions. In 23 unexposed Marshallese undergoing thyroid surgery under the auspices of the Brookhaven medical program, 2 (9%) had occult carcinomas. Reports from the Atomic Bomb Casualty Commission in Japan indicated that occult thyroid carcinomas were increased by radiation exposure (Sampson et al., 1969), although there is at least one subsequent study from Nagasaki that found no such increase (Wakabayashi et al. 1983). In the exposed Marshallese a similar effect may also be present, for based on results of surgical exploration, 6 of 24 (25%) of Utirik persons exposed to radiation (thyroid-absorbed doses ranging from 170 to 680 cGy) had occult carcinomas. However, in the Rongelap group, whose thyroid doses ranged from about 400 to 5200 cGy, only 1 of 28 (4%) had the diagnosis of occult papillary carcinoma. If only those Rongelap individuals with doses less than 2000 cGy are analyzed, 1 of 13 (8%) had an occult carcinoma, and for those receiving over 2000 cGy the prevalence is 0%. Therefore, the high radiation dose received on Rongelap may have decreased rather that increased the incidence of the occult tumors.

But a factor that renders any conclusion of questionable value is that in many of the surgical explorations the entire thyroid gland was not removed and subjected to the close histologic examination that has been used in most studies on occult papillary carcinoma prevalence. The Marshallese data may, therefore, underestimate the prevalence of these lesions, particularly in the multinodular adenomatous goiters of the exposed Rongelap children.

The combined number of occult papillary carcinomas and overt carcinomas in the Rongelap and Utirik groups is virtually identical, being 7.0% in the former and 6.6% in the latter:

	Rongelap	**Utirik**
Exposed persons	86	167
Occult CA	1	6
Overt CA	5	5
Total CA	6	11
Exposed/Total CA	7.0%	6.6%

There are proportionally more carcinomas in the Rongelap group and more occult papillary carcinomas in the Utirik. One might wonder whether radiation exposure had the effect of inducing or hastening a change toward increasing virulence in the usually benign-acting "occult" lesions. However, such an interpretation does not take into account either the limitations on technique of histological examination of the thyroid mentioned in the preceding paragraph or the extensive thyroid injury in those in the Rongelap group who received more than 2000 cGy to the thyroid.

8) Did thyroxine suppression decrease the incidence of benign and/or malignant nodules in radiation-exposed persons?

Administration of thyroxin for the purpose of suppression of development of thyroid nodules in Marshallese who had been living on Rongelap at the time of exposure was initiated in 1965 shortly after the first thyroid nodules were detected (Conard et al., 1967). The distribution of thyroxine, subsequently extended to include those persons who were on nearby Ailingnae atoll, has been continued up to the present, with dose being determined by the results of yearly tests of thyroid function. Utirik patients are not routinely managed with thyroxine suppression. It is given to them only when clinically indicated as noted below. Every six months a supply of tablets is handed out to each exposed Rongelap person, whether or not that person appears for examination, and clinical decisions relating to thyroxine use are made each year by endocrinologic consultants who accompany the medical team during their work in the Marshall Islands. Thyroxine is also given to all persons who had thyroid surgery under the auspices of the Marshall Islands Medical Program, whether exposed or not, for replacement and suppression.

The value of suppressive therapy in prevention of thyroid cancer and benign nodule formation is not clearly determined. Various studies, for the most part carried out on persons who previously had treatment for thyroid nodules, have indicated (1) no nodule suppressive effect (DeGroot et al., 1983), (2) no cancer suppressive effect (Cady et al., 1983), (3) no suppression of benign nodules (Geerdsen and Frolund, 1984), and (4) a decrease in benign nodules but not malignant nodules (Fogelfeld et al., 1989). One study found that thyroxine reduced the number of recurrences in those who had previously undergone therapy for papillary thyroid carcinoma (Schneider et al., 1986), although the number of patients not given suppressive therapy was small. The timing of thyroxine prophylaxis may be an important factor in determining its effectiveness; if started some years after exposure its value may be lessened (DeGroot et al., 1983).

Any conclusions derived from the results of the Marshallese program have scientific limitations. The Rongelap group has been receiving thyroxine suppression since 1965 but it is known that compliance with this regimen is poor, estimated at no better than 50% (Adams et al., 1983). The suppression was not initiated until 10 years after exposure. The number of persons in the Rongelap group is small and many were children at the time of exposure, thereby introducing sample size and age factor into the analysis. Finally, variations in the thyroid-absorbed radiation dose were primarily dependent on age at exposure, and therefore extensive destruction of thyroid tissue with a consequent decrease in risk of thyroid cancer may have occurred in the younger individuals (NCRP, 1985).

One inference is extractable from the Marshallese data by examining the ratios of benign to malignant nodules (Table 3, column B). The Utirik population, which received no thyroxine suppression, had ratios of about 3.5:1 in children less than age ten and 3.7:1 in older children and adults, respectively. In the exposed Utirik group over the age of 10 the number of carcinomas which developed was 3 and the number of benign nodules was 11. On the other hand, in the Rongelap group over the age of 10, which was receiving thyroxine suppression, the number of carcinomas that developed was 4 and the number of benign nodules only 5 with a ratio of 1.25:1. Based on the number of thyroid cancers in the Utirik group, the number of benign Rongelap nodules in those exposed when they were over 10 years of age should have been about 15. That the relatively low number of benign nodules in this group was not the result of the higher radiation dose is seen in the plethora of benign nodules and the highest ratio of benign to malignant nodules in Rongelap children under ten years of age, all of whom received over 2000 cGy.

Thyroxine suppression may have resulted in the development of fewer benign nodules in the older population. (See above for the discussion concerning the limitations of the validity of this interpretation). It is not possible to determine if thyroxine prevented the development of benign nodules in Rongelap children under 10 years of age, in part because 15 of the total of 18 adenomatous nodules in this group had been detected within five years of starting suppression therapy and therefore were unlikely to have been much affected by prophylaxis. The incidence of thyroid cancer in Rongelap persons over 10 years of age was 7% and in the comparable Utirik population persons 4%. The incidence in the former might have even been higher without thyroxine suppression but this will never be proven.

9) Did fetal radiation exposure produce thyroid nodules?

It is known that ^{131}I given in pregnancy can produce hypothyroidism in the fetus (Fisher et al., 1963). Since the fetal thyroid begins to concentrate iodine at about the twelfth week of pregnancy risk of fetal thyroid injury from radioiodines begins at this time. Those fetuses at the time of exposure to BRAVO fallout received both a whole-body dose of gamma radiation equal to their mothers' and a radioiodine dose to the thyroid which was a function of age of gestation, maternal radioiodine dose and the extent of placental transfer of the radioisotope. The placenta is not a barrier to iodine transfer (Fisher, 1975).

Twelve persons followed by the Marshall Islands Medical Program were in utero at the time of exposure, four from Rongelap and eight from Utirik. Three of these have now developed thyroid nodules: two of the four Rongelap children and one of the seven Utirik children (the eighth person in the latter group has never been available for examination). Table 5 summarizes the in utero exposure data. The finding that nodules (all benign) have occurred in at least 27 percent of those in utero at exposure is striking, particularly since the thyroid doses were not calculated to be very high in two of the three (Nos. 3 and 8, Table 5). None of those irradiated in utero have become spontaneously hypothyroid. Since the external whole-body dose estimates are probably fairly accurate, it may be that the internalized dose was higher in the three persons with nodules than was estimated. All the external and internal thyroid doses calculated by Lessard et al. (1985) were derived from a variety of data on radiation sources and conditions, and that report states that the maximum thyroid-absorbed dose could have been as much as four times the mean values used herein. Alternatively, the fetus may be more susceptible than the adult to radiogenic thyroid nodules and perhaps even more so than the juvenile thyroid. Among 2,802 Japanese atomic bomb survivors who were in utero at the time of exposure, 16 have developed cancers that appeared after the age of 14 years. One of these was a thyroid cancer which occurred in a person whose gestational age was 22 weeks at exposure (Yoshimoto et al., 1988).

Table 5: Thyroid nodules occurring in those exposed *in utero*.

ID No.	Gestation age at exposure (in weeks)	Estimated thyroid dose* (cGy)	Nodule type
1	23	870	Adenomatous nodule
2	24	870	
3	10	190	Adenomatous nodule
4	4	190	
5	17	270	
6	24	110	
7	16	270	
8	33	110	Occult papillary cancer**
9	24	110	
10	32	110	
11	35	110	
12	Never examined:		gestational age unknown

* Estimated total thyroid-absorbed dose, including internal and external exposures.
** Dividend opinion among the four consultants on the Pathology panel: occult papillary carcinoma (2) vs. adenomatous goiter (1) vs. nodule with fibrosis (1).

This reports shows that the mortality rate of the exposed Marshallese is no different from the unexposed population. The exposed population and the comparison group are too small in number to determine if there is a statistically significant difference in the incidence of neoplasia other than that of the thyroid. Ingestion of radioactive iodines by the exposed population, including the lesser exposed Utirik group, has resulted in an evident increased incidence of thyroid neoplasia even though this group is small, as is the comparison population. In the Rongelap group, one neoplastic nodule has been diagnosed in the prior ten years and several neoplastic nodules have been diagnosed in the Utirik group during the same time period. The increased risk of formation of thyroid neoplastic nodules appears to still be present, although probably at a decreasing rate.

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3/88, 9/88, 3/89, 9/89, 3/90, 9/90, 3/91, 9/91,	Med. Dept., Brookhaven Natl. Lab, Upton, NY 11973
3/88, 9/89, 3/90	Armer Ishoda Mem. Hosp., Majuro, MI 96960
3/90	Walter Reed Army Medical Center, Washington, D.C.
9/90	Armer Ishoda Mem. Hosp., Majuro, MI 96960
3/91	Armer Ishoda Mem. Hosp., Majuro, MI 96960
5/87, 9/87, 3/88	Armer Ishoda Mem. Hosp., Majuro, MI
3/88, 3/89,	Med. Dept., Brookhaven Natl. Lab, Upton, NY 11973

PRIVACY ACT MATERIAL REMOVED

TECHNICAL SPECIALISTS PARTICIPATING IN THE 1988-91 MARSHALL ISLAND SURVEYS

NAME	PARTICIPATING SURVEY	AFFILIATION
	3/91	Armer Ishoda Mem. Hosp., Majuro, MI
	9/89	Santa Fe, NM
	3/88, 9/88, 3/89, 9/89, 3/90, 3/91, 9/91	U.S. Dept. of Energy, Majuro, MI 96960
	9/88, 3/88, 3/89, 9/89, 3/90, 9/90, 3/91, 9/91,	Med. Dept., Brookhaven Natl. Lab, Stationed at Ebeye, MI
	9/88	Pensacola, FL
	3/91	Garden City, NY
	3/89	Med. Dept., Brookhaven Natl. Lab, Upton, NY 11973
	3/91, 9/91	Honolulu, HI
	3/90	Med. Dept., Brookhaven Natl. Lab, Upton, NY 11973
	3/88, 9/88, 3/89, 9/89, 3/90, 9/90, 3/91, 9/91	Med. Dept., Brookhaven Natl. Lab, Upton, NY 11973
	9/88, 3/89, 3/90, 9/91	Ebeye Hosp, Ebeye, MI 96960
	3/88, 3/89, 3/90	Med. Dept., Brookhaven Natl. Lab, Upton, NY 11973
	3/89, 9/89, 3/90, 9/90, 3/91, 9/91,	Majuro, MI
	3/91	Armer Ishoda Mem. Hosp., Majuro, MI
	3/89	Armer Ishoda Mem. Hosp., Majuro, MI

PRIVACY ACT MATERIAL REMOVED

3/89	Chief, Radiology, Nuclear Medicine	VA Hosp., White River Jct., VT
9/89	Nursing	CRC, Med. Dept., Brookhaven Natl. Lab, Upton, NY
3/90, 3/91	Assist. Prof. Dept. of Obstetrics/Gynecology	Univ. of Wisconsin, Madison, WI
5/89, 3/89	Prof. of Obstetrics/Gynecology	Dept. of OB/GYN, Univ of Med. School, Minn, MN
3/89, 3/93	Nurse	Armer Ishoda Mem. Hosp., Majuro, MI
3/89, 3/90, 3/91	Nurse	Armer Ishoda Mem. Hosp., Majuro, MI
3/91	Nurse	Armer Ishoda Mem. Hosp., Majuro, MI
3/88	Internal Medicine, Attending Physician	NY Univ./Bellevue NYC, NY
3/90	Nurse	Armer Ishoda Mem. Hosp., Majuro, MI
9/90	Opthalmology	Private Practice, NYC, NY
3/91	Endocrinology	Winthrop Univ. Hosp., Mineola, NY
9/91	Pediatrics	Boston Childrens Hosp., Boston, NY
3/91	Internal Medicine	Natl. Instit. of Health, Bethesda, MD
3/89	Family Practice, Director of Diabetes Program, Zuni Wellness Ctr.	Zuni PHS Indian Hosp., Zuni, AZ
3/91	Prof. of Radiology	Univ. of Iowa, IA
3/90	Nurse	College of Micronesia, Majuro, MI

PRIVACY ACT MATERIAL REMOVED

3/89	Nurse	Armer Ishoda Mem. Hosp., Majuro, MI
3/90	Fellow, Pulmonary Diseases	Walter Reed Army Medical Center, Washington, D.C.
3/90	Nurse	Armer Ishoda Mem. Hosp., Majuro, MI
3/89	Chief of Opthamalogy	Walter Reed Army Medical Center, Washington, DC
3/90	Prof. of Medicine	Oregon Health Sciences Univ., Portland, Oregon
	Obsterics/Gynecology	Univ. of Miami School of Med., Miami, FLA
3/90, 3/91	Fellow, Endocrinology Instructor, Endocrinology	NIH; Dept. of Rad., Metro Health Medical Ctr., Clevland, OH
3/90	Nurse	Armer Ishoda Mem. Hosp., Majuro, MI
9/88	Nurse	Armer Ishoda Mem. Hosp., Majuro, MI
3/88	Prof., Dept. of Obsterics/Gynecology	Univ. of Miami School of Med., Miami, FLA
9/89	Emergency Medicine	USAKA Hosp., Kwajalein, MI
3/89	Obsterics/Gynecology	Retired, Womens & Childrens Med. Ctr., Minneapolis, MN
3/90	Assoc. Prof. of Medicine, Endocrinology	Michael Reese Hosp., Univ. of Ill., Chicago, IL
3/88, 3/89, 3/90	Chief of GI Section, Gastroenterology	Woodhull Med. Ctr, Brooklyn, NY
3/91	Internal Medicine	N.E. Deaconess Hosp., Boston, MA
5/87	Obstetrics/Gynecology	Stony Brook Univ. Hosp., Stony Brook, NY
9/88	Nurse	Armer Ishoda Mem. Hosp., Majuro, MI

PRIVACY ACT MATERIAL REMOVED

3/90	Assist. Prof., Division of Gynecology	Univ. of Miami Med. School, Miami, FL
3/91	Ophthalmology	Trippler Army Medical Center, Honolulu, HI
3/89	Chief Resident Opthalmology	Walter Reed Army Medical Center, Washington, DC
3/90	Prof. and Chairman, Dept. of Pediatrics	SUNY Health Center, Brooklyn, NY
3/89, 9/89, 3/91	Rheumatology Fellow/Internal Medicine	Div. of Rheumatology Medical College of Penn., Philadelphia, PA
3/91	Opthalmology	Trippler Army Medical Center, Honolulu, HI
3/89	Assist. Prof. Clinical Medicine, Endocrinology	SUNY Stony Brook, Stony Brook, NY
3/88, 3/91	Family Practice (former Resident Physician)	Maine Med. Ctr., Portland, ME 04103
3/89	Nurse (Retired)	Armer Ishoda Mem. Hosp., Majuro, MI
3/91	Nurse	Armer Ishoda Mem. Hosp., Majuro, MI
9/91	Asst. Director, MIMP, Internal Medicine Hematology/Oncology	Med. Dept., Brookhaven Natl. Lab, Upton, NY
3/90	Prof. of Radiology	Oregon Health Sciences Univ., Portland, Oregon
3/88	Chief of Medicine, Internal Medicine	Worster State Hosp. Univ. of Mass. Med. School, Worster, MA
3/88	Nurse	Armer Ishoda Mem. Hosp., Majuro, MI
3/88	Radiology Resident	The NY Hosp/Cornell NY, NY
3/88, 9/88, 3/89, 9/89, 3/90, 3/91, 9/91	Nurse (Retired)	BNL-MIMP Ebeye, MI

PRIVACY ACT MATERIAL REMOVED

APPENDIX A

PROFESSIONAL STAFF PARTICIPATING IN THE 1988-91 MARSHALL ISLANDS SURVEYS

NAME	PARTICIPATING SURVEY	SPECIALTY	AFFILIATION
^	3/88, 9/88, 3/89, 3/90, 9/90, 3/91, 9/91	Head, CRC, 1986-1990, Director, MIMP, Internal Medicine, Hematology	Medical Dept., Brookhaven Natl. Lab, Upton, NY 11973
	3/89, 3/90	Chief, Endocrine Section Assoc., Prof. of Medicine	Case Western Reserve Univ., Cleveland, OH
	3/88	Assist. Prof. of Medicine, Internal Medicine, Endocrinology	Dartmouth Medical School, Hanover, NH
	9/91	Ped. Dentistry	Rutgers University, Newark, NJ
	9/87, 9/89, 3/91	Prof. of Medicine, Gastroenterology, Internal Medicine	Boston City Hospital, Boston, MA 02118
	3/91	Nurse	Kwajalein Hosp., M.I.
	3/89	Instructor of Medicine, Internal Medicine	Med. College of Penn., Phila., PA
	3/90	Internal Medicine Pulmonary	Walter Reed Med. Ctr., Washington, D.C.
	3/88, 3/91	Pharmacy	Med. Dept., Brookhaven Natl. Lab, Upton, NY
	3/91	Cardiology	Mayo Clinic, Rochester, MN
	9/88	Family Practice	Private Practice, Houston, TX; Kwaj Hosp., Kwajalein, MI
	3/89	Prof. of Surgery	Case Western Reserve Univ., Cleveland Gen. Hosp., Cleveland, OH

PRIVACY ACT MATERIAL REMOVED

APPENDIX B

Individual Marshallese laboratory data collected during 1988 through 1991 medical surveys. (* = exposed persons of Rongelap and Ailingnae; ** = Utirik exposed; *** = Comparison group).

Abbreviations:

PID	=	Brookhaven National Laboratory identification number
SEX	=	1 - Male; 2 - Female
AGE	=	years
WBC	=	leukocyte count/μl
PMN	=	neutrophil count/μl
BAND	=	band forms/μl
LYMPH	=	lymphocytes/μl
MONO	=	monocytes/μl
EOS	=	eosinophils/μl
BASO	=	basophils/μl
PLT	=	platelet count x $10^3/\mu$l
HCT	=	percent
RBC	=	erythrocytes X $10^6/\mu$l
MCV	=	mean corpuscular volume in fl (cu. microns)
HGB	=	hemoglobin level in g/dl
TSH	=	thyroid stimulating hormone level in μIU/ml
PRL	=	serum prolactin in ng/ml
FBS	=	fasting blood sugar in mg/dl
HBA1C	=	glycosylated hemoglobin A1C in percent
RBS	=	random blood sugar in mg/dl
CAL	=	calcium in mg/dl
TPR	=	total protein in g/dl

APPENDIX B (CONT'D)

NOTES: Series of 9's indicate test not performed.
Series of 0's indicate test performed but results below lower limit of detection.
Normal values for the laboratory are those of the U.S. population. Detailed ranges are on file at Brookhaven National Laboratory.

COMPUTER LISTING OF 1988 RAW DATA

PID	SEX	AGE	WBC	PMN	BAND	LYMPH	MONO	EOS	BASO	PLT	HCT	RBC	MCV	HGB	TSH	PRL	FBS	HBA1C
2	1	35	9900	99999	99999	99999	99999	99999	99999	999	43.7	4.46	98.0	15.4	6.60	8.4	999.9	99.9
3	1	35	11200	5824	112	3920	784	560	0	275	43.3	4.41	98.0	13.3	999.99	999.9	999.9	99.9
4	1	72	7400	3108	0	3626	148	518	0	205	44.7	5.18	86.0	15.0	.40	2.9	392.0	10.2
5	1	35	5200	2496	52	2236	104	312	0	255	43.3	4.57	96.0	14.3	1.90	3.7	999.9	99.9
6	1	35	9600	6336	0	2784	96	288	96	190	46.0	4.65	99.0	14.9	1.80	6.8	999.9	99.9
7	1	68	7500	3375	75	3675	225	75	75	278	42.2	4.37	97.0	13.7	.08	5.9	999.9	99.9
8	2	35	11300	5537	113	3503	565	1130	452	295	45.1	4.84	93.0	14.6	.04	2.5	999.9	99.9
9	1	54	9400	5545	0	3008	470	376	0	245	46.9	4.63	101.0	14.7	1.30	2.3	999.9	99.9
10	1	58	6900	4070	0	2070	207	483	69	999	41.7	4.92	85.0	13.9	1.30	4.1	999.9	99.9
12	2	50	9100	4459	0	4004	273	364	0	403	40.9	4.87	84.0	13.5	2.80	3.0	186.0	99.9
14	2	58	7300	2993	0	3577	438	292	0	355	38.9	3.92	99.0	13.1	.20	7.3	999.9	99.9
15	2	41	10400	4784	104	3328	520	1560	104	355	44.9	4.73	95.0	13.8	8.50	7.0	999.9	99.9
16	1	73	6100	3233	122	2013	305	427	0	295	44.3	5.70	78.0	13.4	7.90	5.4	999.9	99.9
17	2	37	6500	3575	0	2470	325	130	0	213	38.5	4.22	91.0	12.8	.09	12.3	999.9	99.9
18	2	55	7800	4368	0	2808	78	546	0	275	43.0	4.78	90.0	13.8	3.40	20.6	999.9	99.9
19	1	39	7100	5183	0	1633	0	284	0	358	43.2	5.65	76.0	14.0	7.00	5.3	999.9	99.9
20	1	40	6500	4030	130	1755	260	325	0	220	47.8	5.57	86.0	15.8	.10	4.9	999.9	99.9
21	2	36	6200	3658	0	2046	310	124	0	433	35.3	4.44	80.0	11.6	.04	8.9	999.9	99.9
22	2	50	5500	2695	0	2255	110	440	0	298	38.2	4.03	95.0	13.5	1.90	11.5	999.9	99.9
24	2	47	6400	2304	64	3392	64	576	0	233	43.6	4.80	91.0	14.0	3.00	3.2	999.9	99.9
33	2	35	10700	7918	0	1819	749	214	0	375	37.9	4.62	82.0	12.3	5.90	100.0	999.9	99.9
34	2	78	8400	3444	84	4368	168	336	0	265	35.7	3.53	101.0	12.1	.20	1.9	999.9	99.9
36	1	41	8100	4860	0	2592	405	162	81	195	37.0	3.80	97.0	12.6	111.00	8.7	999.9	99.9
39	2	48	8500	3995	0	3995	255	85	170	450	40.9	4.31	95.0	12.8	1.90	2.4	999.9	99.9
40	1	63	8300	3403	83	4648	0	166	0	405	45.0	4.59	98.0	13.9	2.80	7.7	999.9	99.9
41	1	75	6900	3795	207	2484	345	69	0	205	41.2	4.35	95.0	14.2	.08	9.5	999.9	99.9
42	2	36	9500	6650	0	2090	665	95	0	178	39.9	3.95	101.0	13.6	1.40	3.3	999.9	99.9
44	1	38	6400	2560	0	2880	448	512	0	285	47.4	5.53	86.0	15.0	2.40	5.1	999.9	99.9
45	2	65	9300	5208	0	2976	465	465	186	325	36.5	3.69	99.0	12.7	.10	7.4	125.0	99.9
47	1	42	8600	5332	172	2150	344	602	0	235	45.9	4.27	107.0	15.4	.05	2.2	999.9	99.9
48	2	39	8100	5103	0	2511	324	162	0	315	37.8	3.79	100.0	12.5	2.90	17.8	999.9	99.9
49	2	50	9700	4462	0	4074	485	582	97	300	40.9	4.57	89.0	13.6	.50	4.0	289.0	10.9
53	2	41	6900	3312	0	3174	345	69	0	999	40.8	4.45	92.0	14.0	10.20	7.1	999.9	99.9
61	2	42	9700	3686	0	4850	291	873	0	324	46.5	5.25	89.0	15.1	8.50	10.9	399.0	13.4
63	2	69	6600	2772	66	3432	66	198	66	295	44.4	4.80	92.0	14.3	0.00	7.9	999.9	99.9
64	2	64	6300	3465	0	1953	252	567	63	179	39.2	4.08	96.0	12.7	156.00	8.0	999.9	99.9
66	2	63	7800	3666	156	3588	234	156	0	408	38.9	4.36	89.0	12.8	1.30	8.7	999.9	99.9
67	2	47	7700	3542	0	3311	231	616	0	305	43.8	4.53	97.0	13.8	3.20	4.9	999.9	99.9
70	2	50	7300	3723	0	1752	438	1095	292	253	38.1	4.55	84.0	12.9	.30	7.2	103.0	4.4
71	2	60	8100	4860	81	2349	162	567	0	340	36.1	3.78	96.0	11.3	3.70	3.6	98.0	99.9
72	2	41	11200	6944	224	3584	336	112	0	615	40.3	4.59	88.0	13.3	0.00	8.0	999.9	99.9
73	1	52	6800	99999	99999	99999	99999	99999	99999	240	50.0	5.09	98.0	15.8	.50	2.7	999.9	99.9
74	2	49	12800	6784	384	4608	512	384	128	280	45.5	5.03	90.0	15.8	.60	7.1	999.9	99.9
75	2	45	10800	5832	0	2808	432	1512	108	280	42.1	4.49	94.0	13.5	7.50	6.8	131.0	5.5
76	1	44	7300	3723	0	2993	219	365	0	308	47.1	4.81	98.0	15.2	3.60	11.0	999.9	99.9
78	2	60	7700	3465	77	3542	462	154	0	283	42.1	4.28	98.0	13.7	0.00	5.9	999.9	99.9
81	2	42	7100	4473	0	2272	284	71	0	292	32.7	3.60	91.0	12.0	2.60	12.2	999.9	99.9
83	1	33	7300	2482	73	3285	803	657	0	290	52.0	5.09	102.0	17.1	0.00	10.3	97.0	99.9
85	1	33	10300	5253	103	4223	618	103	0	308	50.3	5.34	94.0	16.0	2.70	3.9	999.9	99.9
86	2	33	6300	4599	0	1260	63	378	0	345	37.2	4.61	81.0	11.9	2.80	7.6	999.9	99.9
805	2	34	5600	1400	0	2632	672	896	0	345	36.9	4.28	86.0	11.9	999.99	999.9	999.9	99.9
811	2	34	10900	4360	109	5559	436	218	218	290	38.5	3.98	97.0	13.2	1.90	1.9	92.0	99.9
815	1	37	5400	3348	0	1728	108	162	54	258	45.6	4.78	95.0	14.8	999.99	999.9	999.9	99.9
816	2	38	7200	4104	144	2592	216	432	0	245	40.5	4.58	88.0	13.0	.70	999.9	999.9	99.9

COMPUTER LISTING OF 1988 RAW DATA

PID	SEX	AGE	WBC	PMN	BAND	LYMPH	MONO	EOS	BASO	PLT	HCT	RBC	MCV	HGB	TSH	PRL	FBS	HBA1C
822	1	42	5900	3481	59	1711	531	118	0	245	45.3	4.97	91.0	13.9	0.00	999.9	103.0	4.6
823	1	44	9000	2160	0	2880	450	3510	0	325	49.5	5.11	97.0	15.9	999.99	999.9	999.9	99.9
825	2	46	7800	4056	156	2964	234	390	0	330	39.2	4.74	83.0	12.8	999.99	999.9	999.9	99.9
826	2	51	5500	3300	55	880	330	825	110	240	36.2	3.93	92.0	11.6	999.99	999.9	999.9	99.9
827	1	47	7900	4582	79	2212	553	474	0	315	47.8	4.95	97.0	14.4	999.99	999.9	100.0	99.9
829	2	50	5200	3068	0	2080	52	0	0	373	38.6	4.11	94.0	12.3	0.00	15.6	999.9	99.9
830	1	49	5900	2006	59	1593	59	2124	59	288	40.2	4.17	96.0	13.1	999.99	999.9	111.0	5.2
831	1	47	10700	5350	0	3852	749	749	0	278	51.9	5.68	91.0	17.0	999.99	999.9	999.9	99.9
832	2	50	7100	4260	71	2627	0	142	0	300	40.0	4.95	81.0	13.2	999.99	19.2	200.0	99.9
833	1	55	4600	2714	92	1656	92	46	0	255	47.2	5.62	84.0	15.2	999.99	999.9	999.9	99.9
834	1	54	8300	4482	0	2739	498	332	249	390	45.2	4.99	91.0	15.0	999.99	999.9	999.9	99.9
839	2	60	7700	3465	77	3311	539	308	0	220	41.2	4.41	93.0	13.5	999.99	999.9	999.9	99.9
840	1	58	8600	3268	0	4300	258	774	0	324	47.4	5.96	80.0	15.3	999.99	999.9	999.9	99.9
841	2	55	6700	3886	0	2144	268	402	0	403	38.5	4.15	93.0	12.7	.70	999.9	141.0	6.5
843	2	59	7300	2628	73	3066	1168	219	0	243	39.3	3.95	99.0	12.9	0.00	999.9	999.9	5.5
844	2	69	7600	4332	76	2508	380	304	0	325	39.1	4.27	92.0	12.9	999.99	999.9	999.9	99.9
845	1	58	6800	3808	68	1836	340	0	136	158	45.9	5.14	89.0	14.2	999.99	999.9	999.9	99.9
851	2	78	7000	3640	70	2590	140	350	210	325	42.9	4.41	97.0	12.9	999.99	999.9	238.0	8.0
865	2	54	10600	5300	106	4134	318	742	0	335	42.2	4.41	96.0	14.1	999.99	999.9	999.9	99.9
867	2	59	8100	3240	162	4050	324	324	0	285	48.4	5.31	91.0	15.6	0.00	999.9	396.0	7.6
879	2	33	8000	4960	80	2480	320	80	80	355	42.0	4.76	88.0	13.7	999.99	999.9	999.9	99.9
881	1	55	6500	3445	65	2730	130	130	0	225	48.0	5.24	92.0	15.7	999.99	999.9	141.0	8.2
882	1	54	6200	2170	0	2728	372	806	124	280	45.9	5.32	86.0	15.3	.20	999.9	999.9	99.9
883	1	76	11800	4838	118	6018	590	236	0	202	42.5	4.12	103.0	14.8	999.99	999.9	999.9	99.9
888	2	59	10000	6400	0	3000	500	0	100	158	38.1	4.16	92.0	13.3	999.99	999.9	999.9	99.9
891	2	39	8800	5456	0	2640	88	616	0	470	39.3	4.31	91.0	13.1	999.99	999.9	999.9	99.9
896	2	48	12200	5002	122	5490	366	1220	0	350	41.9	4.54	92.0	14.2	999.99	999.9	999.9	99.9
911	2	35	5100	1734	0	2652	357	255	102	290	40.8	4.56	89.0	13.9	.80	999.9	999.9	99.9
912	1	34	10100	4949	101	3333	707	909	101	340	42.9	5.03	85.0	14.4	999.99	999.9	999.9	99.9
914	2	53	9700	5626	0	2813	97	873	291	220	38.6	4.29	90.0	12.4	999.99	999.9	999.9	99.9
917	1	67	8100	4959	0	3045	348	261	87	310	45.9	5.05	91.0	14.6	999.99	999.9	184.0	8.0
920	1	56	6300	2898	63	2961	63	315	0	240	47.6	4.91	97.0	15.5	999.99	999.9	158.0	99.9
925	2	37	9700	7081	0	2134	0	194	291	458	40.5	4.74	85.0	13.0	999.99	999.9	999.9	99.9
926	2	37	8100	4050	0	3159	324	486	81	178	46.0	5.33	86.0	14.9	999.99	999.9	999.9	99.9
932	2	63	9000	4500	180	3240	540	450	90	410	36.9	3.93	94.0	12.2	999.99	999.9	999.9	99.9
934	2	63	6700	3283	67	2680	201	469	0	350	35.9	4.18	86.0	12.2	999.99	999.9	999.9	7.0
938	2	55	8300	5063	166	2324	332	415	0	250	40.6	4.57	89.0	13.3	2.10	999.9	999.9	99.9
939	1	42	8100	4941	0	2511	243	324	81	330	51.9	5.64	92.0	15.8	999.99	3.0	115.0	6.2
941	2	87	8300	4980	0	2739	249	249	83	428	39.8	4.12	97.0	12.9	999.99	999.9	999.9	99.9
942	2	73	7200	3744	216	2880	144	216	0	280	38.6	4.03	96.0	12.9	126.00	999.9	134.0	8.8
943	1	57	9000	5670	0	2430	720	180	0	315	46.4	4.95	94.0	15.1	999.99	999.9	999.9	99.9
944	1	63	8300	5312	83	2241	166	415	83	310	44.2	5.18	85.0	15.0	1.60	999.9	999.9	99.9
955	2	36	7900	4740	0	2370	158	395	0	235	35.0	3.67	95.0	12.5	999.99	999.9	999.9	99.9
959	2	39	6300	2016	0	2898	315	945	126	265	40.4	4.49	91.0	13.1	999.99	999.9	220.0	8.4
960	2	36	9000	4950	270	2880	360	450	90	355	41.6	4.74	88.0	13.6	2.40	999.9	999.9	99.9
963	1	60	7000	3570	0	2450	420	490	0	225	44.5	4.74	94.0	13.7	999.99	999.9	999.9	99.9
965	2	44	8400	4704	0	2436	420	840	0	455	38.0	4.39	87.0	12.3	999.99	999.9	215.0	11.5
966	1	56	6400	3328	128	1984	64	768	128	150	42.6	4.39	97.0	13.5	999.99	999.9	999.9	99.9
971	1	45	8100	4617	0	2835	324	243	81	310	45.9	5.05	91.0	14.6	999.99	999.9	999.9	99.9
977	2	42	8900	4895	89	2314	712	801	89	320	40.8	4.57	89.0	13.9	999.99	999.9	260.0	10.5
980	2	35	6200	2170	0	3534	186	248	62	290	42.9	4.85	88.0	14.0	1.00	999.9	999.9	99.9
981	1	34	6600	3431	0	2442	198	396	66	178	46.3	4.97	93.0	15.8	999.99	999.9	999.9	99.9
998	2	40	6400	3072	0	2944	64	192	128	350	43.4	5.02	86.0	14.7	999.99	999.9	322.0	10.3
1001	2	54	5500	2145	220	2915	165	55	0	318	40.0	5.06	79.0	13.7	999.99	999.9	999.9	99.9

COMPUTER LISTING OF 1988 RAW DATA

PID	SEX	AGE	WBC	PMN	BAND	LYMPH	MONO	EOS	BASO	PLT	HCT	RBC	MCV	HGB	TSH	PRL	FBS	HBA1C
1007	1	77	6200	3224	0	2542	186	248	0	194	34.4	3.81	90.0	11.6	999.99	999.9	120.0	6.9
1035	2	37	9000	4500	0	3600	180	540	180	348	47.6	5.22	91.0	15.2	999.99	999.9	259.0	8.3
1036	1	36	6700	3015	0	3417	134	67	67	205	53.7	6.13	88.0	17.2	999.99	999.9	271.0	8.5
1519	1	45	5500	3245	55	1705	495	0	0	270	48.1	5.19	93.0	15.6	999.99	999.9	140.0	6.9
1520	2	57	6300	2394	0	3528	189	126	63	345	44.8	5.21	86.0	14.4	999.99	999.9	148.0	7.3
1524	1	45	12800	4096	256	7680	640	128	0	420	49.0	5.10	96.0	16.3	999.99	999.9	999.9	99.9
1525	2	45	7800	4055	0	2340	312	1170	78	171	39.1	4.12	95.0	13.4	999.99	999.9	999.9	99.9
1526	1	57	11800	6018	0	2478	708	1888	0	280	41.5	4.63	90.0	13.4	999.99	999.9	999.9	99.9
1533	1	35	9900	5544	0	3663	297	396	0	999	47.5	5.86	81.0	15.6	999.99	999.9	999.9	99.9
1541	2	60	6800	2584	68	381	136	136	68	215	40.9	4.44	92.0	13.0	999.99	999.9	999.9	99.9
1542	2	35	9600	4992	0	4320	192	96	0	270	45.8	5.78	79.0	15.9	999.99	999.9	316.0	11.5
1546	1	74	7700	4697	154	2618	0	231	0	195	47.3	4.93	96.0	15.0	999.99	999.9	193.0	99.9
1548	2	46	9000	5760	90	2340	450	360	0	420	38.8	4.22	92.0	12.3	999.99	999.9	999.9	99.9
1549	1	35	7700	3465	0	3234	693	231	77	478	45.8	4.97	92.0	14.7	999.99	999.9	999.9	99.9
1556	2	43	4000	1600	0	1760	160	480	0	573	40.6	4.14	98.0	13.0	5.70	999.9	999.9	99.9
1561	2	70	8400	4956	252	2520	168	420	84	320	42.1	4.28	98.0	13.4	999.99	999.9	999.9	99.9
1562	1	34	14800	8732	0	3700	1184	1184	0	228	53.1	5.48	97.0	16.6	999.99	999.9	999.9	99.9
1563	1	52	8100	3888	0	3645	486	0	81	230	48.2	5.11	94.0	15.1	999.99	999.9	999.9	99.9
1564	2	39	9900	4653	99	3564	495	1089	0	280	42.2	4.70	90.0	13.3	999.99	999.9	999.9	99.9
1565	1	43	11000	5280	0	3960	550	1100	110	348	51.5	5.37	96.0	16.5	999.99	999.9	999.9	99.9
1566	2	38	6200	2666	0	2728	124	620	62	230	42.8	4.49	96.0	14.8	999.99	999.9	999.9	99.9
1567	2	34	7700	5082	77	1386	385	770	0	348	36.5	4.05	90.0	11.9	999.99	999.9	999.9	99.9
1572	1	40	8600	5848	0	2236	430	0	86	370	53.5	5.88	91.0	16.8	999.99	999.9	999.9	99.9
1573	1	38	9000	2970	0	5040	540	360	90	213	49.3	4.74	104.0	16.0	6.00	999.9	107.0	4.5
1578	2	52	9200	4784	0	3772	368	276	0	395	43.9	5.09	86.0	14.9	999.99	999.9	999.9	99.9
2102	1	44	13700	8220	0	4247	685	274	274	435	52.0	5.29	98.0	16.8	1.10	3.6	999.9	99.9
2103	1	77	7000	3500	140	1750	420	1120	70	370	41.7	4.16	100.0	12.9	.70	999.9	999.9	99.9
2104	2	57	5900	3540	0	1829	177	236	118	245	42.2	4.34	97.0	13.6	1.10	8.7	999.9	99.9
2105	1	87	10000	1900	100	7500	100	300	100	328	39.6	4.44	89.0	13.9	1.40	12.3	999.9	99.9
2106	1	38	16400	8692	164	5740	1148	656	0	315	52.1	5.99	87.0	16.9	2.30	4.3	999.9	99.9
2107	2	59	16800	8400	168	6384	672	840	336	310	43.3	4.69	92.0	14.3	2.70	8.3	140.0	7.4
2108	1	44	7000	3570	0	2940	70	350	0	258	44.0	4.90	90.0	14.9	2.00	15.2	100.0	6.4
2110	1	81	6900	3726	69	2139	828	138	0	260	36.0	3.50	103.0	12.3	3.10	6.4	999.9	99.9
2111	2	37	10100	5454	0	3131	808	707	0	350	39.5	4.87	81.0	14.1	1.40	24.4	192.0	7.2
2113	2	38	6800	3876	68	2380	272	204	0	310	44.9	5.66	79.0	14.2	2.60	2.9	405.0	12.5
2114	1	74	8300	5644	0	2075	332	166	83	255	46.2	4.92	94.0	14.5	1.30	6.9	240.0	8.7
2117	2	58	8100	4698	81	2997	243	81	0	340	44.5	4.87	91.0	14.8	4.10	4.4	387.0	8.5
2119	2	52	10800	6804	0	3132	432	432	0	380	42.5	4.86	88.0	14.6	.90	3.3	999.9	99.9
2124	1	35	9600	5568	0	3072	768	96	96	345	50.7	5.71	89.0	15.5	1.80	38.2	97.0	4.6
2126	2	42	4800	2448	0	1968	48	336	0	460	41.9	4.78	88.0	13.6	1.20	999.9	999.9	99.9
2129	2	51	9300	6696	0	2046	279	186	93	725	30.1	4.04	75.0	10.2	4.10	9.9	346.0	12.1
2130	2	36	10700	4815	107	1926	107	3638	0	330	33.4	3.80	88.0	10.8	1.20	12.7	999.9	99.9
2132	2	35	6500	3640	130	2015	520	195	0	300	40.1	4.86	83.0	13.1	0.00	8.2	999.9	99.9
2136	1	38	8100	4374	0	2592	405	729	0	335	43.6	4.77	97.0	14.3	.30	5.0	999.9	99.9
2137	1	49	5100	1938	0	2499	459	204	0	320	45.0	5.02	90.0	14.6	1.80	4.8	999.9	99.9
2138	2	38	7000	5390	140	1190	210	70	0	430	34.1	3.87	88.0	11.8	.30	21.6	999.9	99.9
2139	2	69	99999	99999	99999	99999	99999	99999	99999	999	99.9	9.99	999.9	99.9	3.40	5.9	999.9	99.9
2140	2	80	5000	3250	100	750	300	600	0	325	32.3	3.48	93.0	10.1	5.10	16.3	999.9	99.9
2142	1	39	10900	6867	0	3161	763	109	0	205	48.2	5.09	95.0	15.5	1.70	8.1	999.9	99.9
2143	1	36	5000	2500	0	2100	250	150	0	435	49.4	5.76	86.0	15.8	3.10	3.9	999.9	99.9
2145	1	67	5600	2128	0	3136	168	112	56	272	45.4	4.69	97.0	13.8	2.80	8.9	122.0	5.9
2148	1	78	7200	3816	72	2880	360	72	0	285	42.9	4.61	93.0	13.9	3.20	5.0	999.9	99.9
2149	2	42	7900	3239	158	2844	474	1185	0	350	36.6	4.05	90.0	12.1	0.00	8.7	999.9	99.9
2150	1	46	8600	4386	0	3870	86	344	0	190	48.0	5.60	86.0	15.8	1.70	2.3	254.0	10.8

COMPUTER LISTING OF 1988 RAW DATA

PID	SEX	AGE	WBC	PMN	BAND	LYMPH	MONO	EOS	BASO	PLT	HCT	RBC	MCV	HGB	TSH	PRL	FBS	HBA1C
2152	1	51	9900	4950	198	3861	396	495	0	325	46.4	4.90	95.0	15.4	0.00	7.9	117.0	99.9
2153	1	35	7500	4050	75	2625	525	150	75	220	41.4	4.94	84.0	13.7	4.20	5.8	150.0	99.9
2155	1	34	6600	3498	0	2574	528	0	0	355	49.3	5.97	83.0	16.5	1.70	3.9	316.0	9.6
2156	1	43	5200	2236	208	2392	260	52	52	350	53.3	5.50	97.0	17.0	1.40	7.9	999.9	99.9
2158	2	63	6500	4225	65	1625	260	325	0	385	39.1	4.37	89.0	12.8	2.50	5.7	999.9	99.9
2160	2	38	9400	3854	0	4982	188	376	0	340	47.3	5.38	88.0	15.6	0.00	4.9	276.0	8.1
2166	1	71	7600	3192	228	3724	228	228	0	210	45.0	4.79	94.0	14.5	4.70	7.5	999.9	99.9
2167	1	48	7200	3168	0	3384	432	216	0	240	43.5	4.81	90.0	14.8	1.00	7.6	999.9	99.9
2171	2	36	8700	4089	0	4002	348	261	0	320	42.6	4.91	87.0	13.9	.20	7.9	217.0	99.9
2172	2	46	7700	4543	0	2002	770	385	0	300	42.9	4.64	92.0	14.2	.04	14.6	237.0	8.3
2174	1	34	9000	5850	0	2160	540	450	0	280	48.9	5.44	90.0	15.9	2.60	4.4	999.9	99.9
2176	1	44	5600	3080	0	2240	112	56	112	285	47.5	5.00	94.0	15.5	1.20	999.9	264.0	10.8
2179	1	37	10100	5757	101	3333	303	404	0	255	52.7	6.20	85.0	16.8	1.00	4.4	999.9	99.9
2182	2	86	4800	2304	0	2088	96	144	96	375	37.3	4.02	93.0	12.2	3.20	32.8	108.0	4.7
2188	1	36	99999	99999	99999	99999	99999	99999	99999	999	99.9	9.99	999.9	99.9	999.99	999.9	999.9	99.9
2193	2	65	4900	2548	49	1813	343	147	0	205	38.7	4.20	92.0	12.7	2.50	7.3	999.9	99.9
2195	2	58	7200	4392	72	2304	216	216	0	360	40.0	4.86	82.0	13.2	1.30	6.2	999.9	99.9
2196	2	72	6200	3162	0	2604	186	248	0	263	37.4	4.08	92.0	12.3	.20	6.0	999.9	99.9
2197	2	35	8400	5628	84	1932	168	588	0	390	34.7	3.80	91.0	11.5	.90	8.7	999.9	99.9
2205	1	63	7900	3713	0	3634	395	158	0	250	43.2	5.34	81.0	14.8	1.00	5.0	192.0	8.4
2206	1	66	6300	3591	63	2142	189	315	0	300	47.7	5.20	92.0	14.9	.90	5.7	999.9	99.9
2207	1	39	5500	1870	0	3245	110	165	110	305	44.7	5.18	86.0	14.6	1.10	3.2	197.0	8.2
2208	2	71	9800	6566	0	2842	98	196	0	385	40.7	4.48	91.0	13.4	.90	7.5	177.0	6.5
2209	2	39	9700	4753	0	3492	582	679	194	365	39.5	4.43	89.0	12.5	1.50	10.9	96.0	99.9
2210	2	34	6800	2992	0	2516	748	544	0	260	45.0	4.96	91.0	14.2	1.30	8.4	999.9	99.9
2215	2	67	10400	6340	0	2700	7592	6448	0	280	42.7	4.77	90.0	13.2	0.00	4.3	162.0	10.2
2216	2	68	9600	5184	0	3744	576	96	0	485	44.4	5.16	86.0	13.8	1.70	17.3	264.0	7.9
2217	2	55	9100	4732	0	2912	182	1183	91	365	38.9	4.11	95.0	12.8	2.20	11.0	999.9	99.9
2220	2	59	7100	4544	71	1917	71	355	142	322	40.3	4.20	96.0	13.1	3.40	3.5	999.9	99.9
2224	2	65	8000	5360	0	1920	320	400	0	370	34.9	3.61	97.0	11.7	1.70	7.6	999.9	99.9
2226	2	36	99999	99999	99999	99999	99999	99999	99999	999	99.9	9.99	999.9	99.9	2.20	12.5	999.9	99.9
2227	2	38	11600	8468	0	2552	348	116	116	423	36.1	4.25	85.0	11.7	1.00	43.7	999.9	99.9
2228	2	42	11100	7548	0	2553	555	222	222	360	41.3	4.65	89.0	13.5	1.40	12.7	999.9	99.9
2229	2	52	7900	3713	79	3002	316	632	158	260	42.7	4.86	88.0	14.2	0.00	6.0	999.9	99.9
2230	2	46	7300	4526	0	2263	73	438	0	420	43.6	5.23	83.0	14.3	.90	3.5	232.0	9.5
2231	2	35	7800	3900	78	3276	312	234	0	650	45.1	5.48	82.0	14.9	1.30	4.0	257.0	8.6
2232	1	36	9400	3854	0	4324	658	376	188	235	53.5	5.46	98.0	16.9	6.20	6.4	999.9	99.9
2233	1	36	6700	3483	0	2948	134	134	0	271	50.2	5.47	92.0	16.2	2.80	2.0	999.9	99.9
2234	1	46	8000	4400	0	3040	560	0	0	385	47.4	5.29	90.0	15.5	2.60	8.5	999.9	99.9
2235	1	41	7100	4047	0	2627	142	213	71	255	47.3	5.12	92.0	14.7	.80	6.4	999.9	99.9
2236	1	45	6000	2520	60	2880	360	180	0	365	40.1	4.64	86.0	14.3	3.80	7.1	999.9	99.9
2237	1	41	8300	3569	0	3735	498	415	83	495	49.0	5.40	92.0	15.6	1.70	4.0	999.9	7.6
2239	2	37	8400	5292	0	2184	336	588	0	338	38.0	4.73	80.0	12.2	.80	10.2	999.9	99.9
2244	2	78	5600	1232	0	3976	112	224	56	205	37.2	3.71	100.0	12.4	3.40	13.1	155.0	7.1
2247	2	42	7400	3996	74	2516	296	518	0	355	35.0	3.74	94.0	11.3	.70	11.2	999.9	99.9
2248	2	49	10100	6767	0	2424	404	505	0	340	41.1	4.78	86.0	13.4	0.00	4.1	237.0	7.0
2251	2	39	8000	4480	0	2880	320	80	240	360	37.1	4.79	77.0	12.3	59.40	26.9	999.9	99.9
2254	2	38	8100	4779	0	2106	324	891	0	425	38.2	4.44	86.0	13.2	3.60	9.0	999.9	99.9
2256	2	39	5800	2900	0	2320	348	232	0	250	42.3	4.77	89.0	13.2	1.40	4.2	391.0	13.3
2257	1	41	7400	4662	74	2368	222	74	0	260	45.2	5.25	86.0	14.3	.70	8.5	99.0	5.3
2260	2	34	6000	2820	0	2880	60	120	120	458	40.5	4.48	90.0	13.0	.20	60.2	999.9	99.9
2261	1	59	5000	2900	0	1900	150	50	0	257	48.0	5.13	94.0	16.4	2.80	16.1	999.9	99.9
2268	1	33	9700	3783	291	4171	582	679	194	260	51.3	5.81	88.0	16.2	2.20	6.8	130.0	4.8
2269	1	33	9600	5952	96	2784	384	384	0	255	50.3	5.30	95.0	15.6	2.00	4.1	999.9	99.9

COMPUTER LISTING OF 1988 RAW DATA

PID	SEX	AGE	WBC	PMN	BAND	LYMPH	MONO	EOS	BASO	PLT	HCT	RBC	MCV	HGB	TSH	PRL	FBS	HBA1C
2271	1	33	8500	2805	0	3910	255	1275	255	305	48.6	5.35	91.0	15.7	2.60	4.1	245.0	8.9
2274	1	33	7600	3572	0	3192	304	532	0	225	48.4	5.54	87.0	15.2	2.40	3.6	999.9	99.9
2277	2	34	8400	5040	0	2772	420	168	0	199	28.1	4.71	60.0	9.5	1.20	24.3	999.9	99.9

COMPUTER LISTING OF 1989 RAW DATA

PID	SEX	AGE	WBC	PMN	BAND	LYMPH	MONO	EOS	BASO	PLT	HCT	RBC	MCV	HGB	TSH	PRL	FBS	HBA1C	RBS	CAL	TPR
2	1	36	9100	4641	0	2548	546	1274	91	235	46.1	4.63	100.0	14.4	.30	5.4	91.0	99.9	999.9	9.7	7.3
3	1	36	10400	5096	104	4160	416	520	0	270	42.9	4.69	91.0	14.0	144.00	16.7	999.9	99.9	102.0	9.4	7.3
4	1	73	7000	2590	70	3360	420	560	0	320	44.3	5.00	89.0	14.5	8.30	7.8	255.0	10.1	244.0	10.2	8.2
5	1	36	5000	2500	0	1700	350	350	100	245	43.5	4.54	96.0	14.4	110.00	12.4	999.9	99.9	64.0	9.5	7.2
6	1	36	9700	7178	0	1358	970	194	0	300	45.0	4.71	96.0	14.6	2.90	7.1	999.9	99.9	75.0	8.7	6.7
7	1	69	6500	1625	65	3965	390	455	0	340	40.6	4.35	93.0	13.3	1.10	7.0	999.9	99.9	102.0	10.0	8.3
9	1	55	7800	5304	0	1950	156	390	0	385	45.1	4.67	97.0	14.1	2.50	3.9	999.9	99.9	152.0	9.1	6.6
10	1	58	8900	7031	0	1246	267	356	0	300	44.3	5.26	85.0	14.1	0.00	7.2	345.0	10.5	389.0	10.1	7.8
12	2	51	5600	99999	99999	99999	99999	99999	99999	999	99.9	9.99	999.9	13.6	2.40	999.9	999.9	8.4	999.9	9.5	7.8
14	2	59	7600	3800	0	3192	380	228	0	255	39.6	4.01	99.0	13.1	3.20	4.7	999.9	99.9	109.0	9.5	7.6
15	2	42	10300	5253	103	3605	52	824	0	335	43.9	4.53	97.0	13.5	4.80	9.5	999.9	11.1	108.0	9.2	7.3
16	1	74	4900	2205	0	2352	147	49	147	168	35.7	4.81	74.0	12.1	5.30	5.5	999.9	99.9	999.9	99.9	99.9
17	2	38	4600	2070	0	1886	506	138	0	225	44.0	4.92	89.0	14.0	0.00	15.1	999.9	99.9	74.0	8.2	7.1
18	2	56	6500	3965	65	1755	325	390	0	245	38.7	4.22	92.0	12.4	6.90	21.5	999.9	99.9	99.0	9.6	7.5
19	1	40	5100	3162	0	1479	153	255	51	295	44.7	5.80	77.0	14.3	81.50	13.3	999.9	99.9	89.0	9.1	6.7
20	1	41	7700	3542	0	2387	385	1309	77	300	49.0	5.80	84.0	16.5	0.00	7.4	40.0	5.4	67.0	9.7	7.1
21	2	37	5800	3480	0	1682	174	464	0	355	41.2	5.03	82.0	13.1	0.00	8.6	999.9	99.9	77.0	5.6	7.2
22	2	50	5800	2610	0	2726	348	116	0	390	39.9	4.11	97.0	13.0	2.80	9.7	999.9	99.9	112.0	9.6	7.0
24	2	48	5100	1785	102	2550	357	255	51	275	44.0	4.97	89.0	14.6	2.60	3.5	999.9	99.9	226.0	9.4	7.5
33	2	36	10100	6161	101	2828	404	606	0	385	43.4	4.71	92.0	14.2	65.50	20.0	999.9	99.9	78.0	9.1	6.9
34	2	79	6200	2728	62	3100	62	124	124	245	38.2	3.68	104.0	12.2	4.70	9.2	999.9	99.9	109.0	8.9	7.2
36	1	42	7500	4350	150	2625	300	75	0	310	38.0	3.92	97.0	12.6	141.00	8.2	999.9	99.9	67.0	9.2	7.9
39	2	49	8200	3444	0	2624	328	1804	0	500	40.6	4.29	95.0	12.6	2.50	2.8	999.9	99.9	116.0	8.9	7.4
40	1	64	4700	2444	0	1880	282	94	47	290	39.7	4.34	91.0	12.7	2.80	7.4	999.9	99.9	228.0	8.5	6.0
41	1	76	5500	2860	0	2365	110	110	55	275	36.8	4.11	90.0	12.5	4.00	8.3	999.9	99.9	91.0	8.8	7.6
42	2	37	7100	3834	0	2627	355	284	0	205	41.6	4.12	101.0	14.1	0.00	2.5	999.9	99.9	103.0	9.6	7.5
44	1	38	7500	4950	0	1725	525	75	225	270	49.2	5.81	85.0	15.7	1.80	5.7	999.9	99.9	113.0	9.0	7.0
45	2	66	5500	2585	0	2530	220	165	0	350	38.5	3.93	98.0	12.5	.60	7.4	999.9	99.9	104.0	9.6	7.5
47	1	43	12800	6656	0	2560	128	3456	0	235	46.8	4.29	109.0	15.5	6.10	6.5	999.9	99.9	107.0	10.2	8.3
48	2	40	10900	7303	218	2180	436	545	109	235	40.0	4.01	98.0	12.9	2.50	35.5	999.9	99.9	89.0	9.5	6.6
49	2	51	5600	2576	0	2632	168	224	0	275	40.8	4.48	91.0	13.3	1.90	4.4	206.0	12.0	199.0	9.7	7.2
53	2	42	9900	6633	99	1584	990	495	0	405	40.6	4.55	89.0	13.3	4.30	7.9	999.9	99.9	97.0	9.5	7.6
61	2	43	7700	5852	0	1617	231	0	0	303	40.2	4.84	83.0	13.2	5.50	9.6	380.0	12.0	999.9	99.9	99.9
63	2	70	6800	3808	0	2312	340	340	0	190	43.9	4.64	95.0	14.0	3.00	5.1	999.9	99.9	112.0	9.5	6.9
64	2	65	6100	2501	0	2928	244	366	61	237	36.8	3.95	93.0	12.1	0.00	4.9	999.9	99.9	999.9	99.9	99.9
65	2	36	5000	2550	0	1600	100	650	100	220	36.3	3.81	95.0	11.4	107.00	33.8	999.9	99.9	93.0	9.1	7.1
66	2	64	11400	7182	0	3534	342	228	114	265	42.4	4.80	88.0	13.1	0.00	8.2	999.9	99.9	174.0	8.7	7.4
67	2	48	6700	3551	134	2345	134	402	134	360	40.0	4.15	96.0	12.7	10.90	6.3	999.9	99.9	108.0	9.2	7.6
70	2	51	6400	3840	0	2048	512	0	0	245	39.0	4.70	83.0	12.9	0.00	10.9	999.9	99.9	77.0	9.4	7.4
71	2	61	7800	3510	0	3666	0	468	156	325	40.9	4.29	95.0	13.4	3.40	7.1	999.9	99.9	112.0	8.7	7.4
72	2	42	6700	2479	67	3417	268	469	0	330	42.3	4.72	88.0	13.6	4.60	10.1	999.9	99.9	163.0	10.2	7.9
73	1	53	6100	3843	0	1769	61	305	122	240	51.0	5.38	96.0	16.4	1.70	4.5	999.9	99.9	114.0	8.5	6.7
74	2	50	11400	5700	114	4674	456	456	0	290	49.0	5.37	91.0	16.1	0.00	10.3	999.9	99.9	176.0	9.8	8.3
75	2	46	9200	3128	0	3680	460	1748	184	325	42.6	4.65	92.0	13.4	8.50	6.8	999.9	99.9	146.0	9.8	7.7
76	1	45	6700	2144	134	3953	134	0	0	215	48.7	4.98	98.0	15.3	1.90	10.3	999.9	99.9	89.0	10.2	7.2
77	1	59	5800	4698	0	812	174	58	58	340	40.7	4.47	91.0	13.3	.80	4.2	999.9	99.9	999.9	99.9	99.9
78	2	70	7800	3354	156	3666	390	156	0	275	40.2	4.11	98.0	13.0	4.70	6.6	999.9	9.4	324.0	9.5	7.1
79	1	74	6400	2816	0	3200	256	64	64	175	49.5	5.55	89.0	16.4	3.00	12.2	139.0	6.7	128.0	9.7	7.8
86	2	34	7900	6004	0	1264	395	158	79	345	40.7	4.79	85.0	13.0	1.50	6.0	999.9	99.9	82.0	9.7	7.9
805	2	35	4600	2254	0	1978	230	92	0	198	37.3	4.41	85.0	12.1	999.99	999.9	999.9	99.9	999.9	99.9	99.9
811	2	35	9700	4268	97	4268	291	388	388	355	44.6	4.70	95.0	13.9	1.80	3.2	999.9	99.9	67.0	10.3	8.7
816	2	39	10700	6955	107	1819	749	1070	0	275	41.6	4.82	86.0	13.4	999.99	999.9	999.9	99.9	81.0	9.2	7.4
822	1	43	5600	2632	0	2296	448	224	0	230	43.0	4.79	90.0	13.9	0.00	999.9	999.9	99.9	97.0	9.5	7.0

COMPUTER LISTING OF 1989 RAW DATA

PID	SEX	AGE	WBC	PMN	BAND	LYMPH	MONO	EOS	BASO	PLT	HCT	RBC	MCV	HGB	TSH	PRL	FBS	HBA1C	RBS	CAL	TPR
823	1	45	7800	4524	78	1872	546	546	234	125	45.9	4.97	92.0	15.2	999.99	999.9	999.9	99.9	85.0	8.9	7.2
825	2	46	8300	5146	83	2739	249	83	0	300	42.1	5.09	83.0	13.4	999.99	999.9	999.9	99.9	84.0	10.2	7.9
826	2	52	3700	1295	555	925	407	407	0	185	34.7	3.74	92.0	11.1	999.99	999.9	999.9	99.9	105.0	9.3	7.5
829	2	51	99999	99999	99999	99999	99999	99999	99999	999	99.9	9.99	999.9	99.9	.10	999.9	999.9	99.9	999.9	9.7	9.1
830	1	50	6300	2583	0	1827	63	1764	63	230	43.7	4.55	96.0	14.0	999.99	999.9	104.0	7.4	98.0	8.8	6.8
832	2	51	5400	2430	0	2484	270	216	0	245	41.6	5.19	80.0	13.4	999.99	999.9	216.0	11.2	212.0	9.3	6.9
833	1	56	3700	1295	0	2072	185	37	111	300	44.3	5.09	87.0	14.1	999.99	999.9	999.9	99.9	999.9	99.9	99.9
835	2	55	12400	6324	124	4960	124	744	124	305	50.2	5.18	97.0	16.4	999.99	999.9	301.0	8.7	999.9	99.9	99.9
838	1	56	9600	4800	0	3840	672	288	0	310	52.0	5.49	96.0	16.6	999.99	999.9	999.9	99.9	86.0	8.9	7.0
840	1	59	9200	3036	0	3496	552	1932	92	305	48.1	6.06	79.0	15.8	999.99	999.9	999.9	99.9	113.0	9.6	7.8
841	2	56	6100	2684	0	2379	183	854	61	999	39.0	4.33	90.0	12.9	.10	9.5	257.0	7.7	999.9	99.9	99.9
843	2	60	6200	3100	0	2356	372	372	0	230	38.4	3.98	96.0	12.5	0.00	999.9	999.9	99.9	137.0	8.9	6.5
844	2	70	11300	8927	0	1695	339	226	113	315	36.5	3.93	93.0	11.4	999.99	999.9	999.9	99.9	83.0	9.0	7.6
845	1	59	8900	6052	89	2136	356	267	0	225	44.6	4.99	89.0	13.8	999.99	999.9	999.9	99.9	88.0	9.5	7.0
851	2	79	11900	6664	0	2856	357	1785	238	260	34.8	3.68	95.0	11.5	999.99	999.9	256.0	8.5	254.0	9.2	7.1
865	2	55	6000	1860	0	3120	540	480	0	375	40.8	4.36	94.0	13.3	2.20	999.9	999.9	99.9	89.0	9.9	7.4
867	2	60	11500	3795	115	5635	230	1725	0	270	44.5	4.83	92.0	14.5	.90	999.9	999.9	8.8	328.0	99.9	7.5
879	2	34	6700	3484	134	2747	0	268	67	245	43.3	4.73	92.0	13.7	999.99	999.9	999.9	99.9	99.0	9.7	7.8
881	1	56	7800	5070	156	2106	390	78	0	380	45.5	5.26	86.0	14.6	999.99	999.9	205.0	10.5	202.0	9.4	7.7
882	1	55	5500	3300	0	1650	275	220	55	185	44.7	5.30	84.0	14.5	999.99	999.9	135.0	7.9	126.0	9.1	7.1
891	2	41	6800	3332	204	2516	408	340	0	379	41.7	4.34	96.0	13.7	999.99	999.9	999.9	99.9	999.9	99.9	99.9
896	2	49	7500	4800	75	2250	300	75	0	280	40.2	4.52	89.0	13.5	999.99	999.9	999.9	99.9	156.0	9.8	7.4
911	2	36	6400	3776	0	1728	128	640	128	305	40.6	4.61	88.0	13.1	999.99	999.9	999.9	99.9	98.0	9.2	7.0
914	2	54	7100	3905	0	2130	355	639	71	335	39.8	4.46	89.0	12.8	1.50	999.9	999.9	99.9	96.0	9.4	6.8
919	1	41	5200	2288	0	2028	312	312	0	290	44.0	5.18	85.0	14.6	1.30	999.9	265.0	99.9	255.0	9.8	8.1
920	1	57	5700	2850	0	2109	342	399	0	260	44.6	4.65	96.0	14.6	999.99	999.9	163.0	7.2	150.0	9.4	7.9
922	2	64	8100	3564	0	3726	405	0	0	385	41.0	4.48	92.0	13.9	999.99	999.9	999.9	99.9	110.0	9.5	7.5
926	2	38	6300	3087	0	2646	189	378	0	250	39.6	4.54	87.0	13.1	1.70	999.9	75.0	3.3	73.0	8.8	6.8
932	2	64	8800	5016	0	2024	1056	616	88	420	38.1	4.17	91.0	12.6	999.99	999.9	999.9	99.9	119.0	9.7	7.9
934	2	64	6900	3243	0	2553	621	345	138	235	40.7	4.97	82.0	13.5	999.99	999.9	357.0	11.9	389.0	10.1	7.8
938	2	56	9000	5310	0	2790	540	450	0	255	43.1	4.87	89.0	13.7	999.99	999.9	999.9	99.9	999.9	9.5	7.9
939	1	43	8100	3969	0	0	0	0	0	270	47.7	5.16	92.0	15.7	999.99	999.9	999.9	99.9	999.9	9.7	7.5
942	2	74	6000	3000	0	2460	240	300	0	305	38.2	4.12	93.0	12.3	5.80	999.9	137.0	7.4	999.9	9.2	7.6
943	1	58	7300	3650	0	3139	219	146	146	395	45.3	4.98	92.0	14.8	.80	999.9	999.9	99.9	999.9	9.9	8.1
944	1	64	7800	4680	78	2418	156	390	78	270	46.7	5.54	84.0	15.4	.70	999.9	176.0	7.1	200.0	10.1	9.3
958	1	57	8900	4717	89	3738	89	89	178	370	38.7	4.20	92.0	12.4	999.99	999.9	999.9	99.9	999.9	9.2	7.2
959	2	40	4900	2107	0	1176	490	1029	98	305	42.6	4.73	90.0	13.7	999.99	999.9	304.0	12.7	318.0	9.5	7.2
963	1	61	5100	1989	0	2550	357	204	0	370	42.0	4.56	92.0	13.2	999.99	999.9	999.9	99.9	999.9	9.2	6.9
965	2	45	7300	4161	0	2117	73	876	73	455	36.8	4.19	88.0	12.1	999.99	999.9	231.0	6.3	221.0	9.0	7.2
966	1	57	4500	2745	0	1440	135	180	0	300	42.1	4.42	95.0	13.2	999.99	999.9	999.9	99.9	999.9	9.5	7.6
971	1	46	8000	4880	0	2640	400	80	0	385	46.9	5.38	88.0	15.1	.40	10.0	999.9	99.9	999.9	11.4	8.1
977	2	43	6900	3726	69	2484	414	138	69	410	44.3	5.16	86.0	14.5	3.20	999.9	302.0	11.0	314.0	9.8	8.6
980	2	36	7000	4200	0	2380	70	280	70	330	44.7	5.05	88.0	14.1	.90	999.9	999.9	99.9	999.9	8.3	6.6
981	1	35	7700	4543	0	2695	231	154	77	280	49.8	5.31	94.0	15.8	999.99	999.9	999.9	99.9	999.9	9.9	7.9
998	2	41	5200	2652	0	1768	364	364	52	285	42.6	4.95	86.0	14.1	999.99	999.9	296.0	10.7	305.0	9.3	7.6
1001	2	55	6600	2706	66	2376	462	990	0	345	39.2	4.87	80.0	13.2	999.99	999.9	999.9	99.9	166.0	9.7	7.4
[illegible]	1	70	4100	2255	82	1271	328	164	0	210	33.5	3.93	90.0	11.8	0.00	999.9	281.0	8.0	360.0	8.7	6.7
1035	2	38	6400	3264	0	2368	128	640	0	290	43.5	4.87	89.0	13.9	999.99	999.9	208.0	7.3	213.0	10.0	7.1
1036	1	37	6800	2720	0	3264	612	136	68	260	50.4	5.90	85.0	16.8	999.99	999.9	187.0	5.9	186.0	9.8	7.1
1043	2	54	7000	3290	0	3010	420	210	70	385	42.6	5.13	83.0	13.8	1.40	999.9	99.0	4.7	999.9	10.1	7.5
1500	1	58	8500	4930	0	2720	255	510	85	405	31.0	3.43	90.0	10.6	999.99	999.9	188.0	10.1	176.0	9.2	7.7
1519	1	46	6700	4422	0	1675	603	0	0	290	51.0	5.56	92.0	16.2	999.99	999.9	211.0	10.7	999.9	10.2	7.5
1520	2	58	8100	4293	0	2997	567	243	0	300	45.3	5.34	85.0	14.5	2.50	999.9	276.0	7.8	186.0	9.2	7.1
1524	1	46	10800	5400	648	3240	0	432	0	255	49.8	5.36	93.0	17.3	999.99	999.9	999.9	99.9	999.9	10.6	99.9

COMPUTER LISTING OF 1989 RAW DATA

PID	SEX	AGE	WBC	PMN	BAND	LYMPH	MONO	EOS	BASO	PLT	HCT	RBC	MCV	HGB	TSH	PRL	FBS	HBA1C	RBS	CAL	TPR
1526	1	58	13600	10336	0	1904	408	952	0	420	35.8	4.13	87.0	12.2	1.50	11.7	132.0	6.4	999.9	9.6	8.4
1530	2	43	6300	3780	63	2079	126	252	0	245	44.1	4.95	89.0	13.9	2.10	999.9	999.9	99.9	999.9	9.7	7.6
1533	1	36	7800	3978	0	2964	624	234	0	310	48.2	5.97	81.0	15.6	999.99	999.9	99.0	99.9	999.9	9.1	7.4
1541	2	61	6400	3648	0	2368	256	128	0	335	41.8	4.74	88.0	13.4	999.99	999.9	999.9	99.9	999.9	9.6	7.4
1542	2	36	5900	2065	0	3481	177	118	59	355	44.1	5.54	80.0	14.6	999.99	999.9	251.0	8.9	263.0	8.9	6.6
1546	1	75	5800	2436	0	2842	406	116	0	121	50.2	5.40	93.0	16.2	999.99	999.9	291.0	9.8	303.0	9.6	7.1
1548	2	47	10600	7102	0	2650	318	530	0	360	38.5	4.23	91.0	12.5	999.99	999.9	999.9	99.9	999.9	8.1	7.0
1549	1	36	9900	4950	99	3861	495	495	0	385	47.3	5.37	88.0	15.4	999.99	999.9	999.9	99.9	999.9	10.2	8.3
1552	1	59	5700	2109	0	2907	456	171	57	345	46.8	5.28	89.0	14.6	999.99	999.9	999.9	99.9	999.9	99.9	99.9
1556	2	44	7100	2556	0	3550	71	923	0	195	40.2	4.16	97.0	13.0	4.70	999.9	999.9	99.9	999.9	9.4	7.3
1558	2	39	6100	2562	0	2806	305	366	61	305	43.3	4.66	94.0	13.8	.03	999.9	999.9	99.9	999.9	9.4	7.6
1559	2	36	9900	6435	0	3069	198	198	0	300	41.6	5.02	83.0	13.3	1.60	999.9	999.9	99.9	999.9	9.5	6.9
1560	2	65	6000	2580	0	2760	480	180	0	205	45.8	4.65	98.0	14.9	999.99	999.9	247.0	10.4	248.0	9.7	7.6
1561	2	71	9000	6120	0	2070	180	450	90	420	40.7	4.18	97.0	13.2	999.99	999.9	999.9	99.9	999.9	9.2	7.0
1564	2	40	9600	4992	0	2688	768	1152	96	405	44.0	4.87	90.0	13.3	12.40	999.9	999.9	99.9	999.9	9.5	7.4
1567	2	35	6400	3520	0	2432	192	256	0	295	35.9	4.05	89.0	11.6	999.99	999.9	999.9	99.9	999.9	9.0	7.7
1573	1	39	9200	5704	92	2852	368	184	92	280	51.1	5.47	93.0	16.3	.02	999.9	999.9	99.9	999.9	99.9	99.9
1577	2	38	10000	5500	100	3900	200	300	0	350	40.2	4.31	93.0	13.3	999.99	999.9	999.9	99.9	999.9	9.2	7.8
1578	2	53	9100	4459	0	3731	364	455	91	445	42.2	5.01	84.0	14.3	1.60	999.9	200.0	8.8	194.0	9.7	6.7
2102	1	45	9900	7227	99	1683	495	297	99	260	47.5	5.11	93.0	16.5	999.99	999.9	999.9	99.9	999.9	99.9	99.9
2103	1	78	4300	2408	0	1333	172	344	43	355	45.4	4.75	96.0	14.9	.80	999.9	97.0	5.2	999.9	9.5	7.5
2104	2	58	4700	2632	0	1880	141	47	0	210	41.4	4.41	94.0	13.5	4.80	9.0	156.0	6.5	151.0	9.8	7.6
2105	1	80	10900	5668	109	3052	763	1308	109	370	40.8	4.61	89.0	13.4	1.30	11.3	999.9	99.9	999.9	9.7	7.8
2106	1	39	10000	5100	0	4600	100	100	100	247	45.8	5.31	86.0	15.6	1.60	5.1	999.9	99.9	999.9	9.8	99.9
2107	2	60	12300	5412	0	4674	861	1230	123	318	45.8	5.30	86.0	13.6	1.90	4.4	999.9	99.9	248.0	10.3	8.2
2108	1	45	6200	3410	0	2356	248	186	0	280	47.2	5.17	91.0	14.4	1.70	7.6	113.0	5.3	999.9	9.7	8.9
2110	1	82	6800	3264	0	2924	408	136	68	320	36.0	3.46	104.0	12.1	2.20	5.0	999.9	99.9	999.9	8.0	6.5
2111	2	38	8200	3854	0	2460	82	1558	246	505	40.8	5.07	80.0	13.8	1.70	17.3	211.0	10.7	228.0	9.5	7.6
2113	2	39	6200	2914	0	2542	310	434	0	370	43.8	5.70	77.0	14.8	2.40	6.4	294.0	11.2	297.0	9.5	7.3
2114	1	75	11400	8436	114	1710	570	456	114	230	40.2	4.40	91.0	12.8	.80	8.0	269.0	9.0	271.0	9.5	7.8
2117	2	59	5700	1938	0	3078	399	228	57	300	45.9	5.03	91.0	14.4	2.80	4.3	289.0	9.4	301.0	9.1	7.4
2119	2	53	14500	5655	0	7540	435	580	145	305	42.7	4.86	88.0	13.8	.50	4.9	999.9	99.9	999.9	10.0	7.5
2124	1	36	6500	3770	65	2210	325	65	65	225	43.9	4.97	88.0	14.8	1.20	32.3	999.9	99.9	999.9	9.6	7.4
2126	2	43	12000	7440	0	3360	480	600	120	305	41.4	4.62	90.0	13.1	1.90	10.4	999.9	99.9	999.9	9.0	7.2
2129	2	52	10200	6222	102	2652	510	714	0	495	38.0	4.85	78.0	13.4	3.20	17.0	331.0	12.7	376.0	8.8	6.4
2130	2	37	9200	6900	0	1564	368	460	0	275	34.8	3.74	93.0	11.4	1.90	28.1	999.9	99.9	999.9	8.8	7.1
2132	2	36	4700	3384	0	846	376	94	0	300	39.2	4.86	81.0	12.8	.03	10.5	999.9	99.9	180.0	9.7	8.4
2134	2	35	6400	3904	0	2112	192	192	0	345	42.1	4.91	86.0	14.0	3.30	10.8	999.9	99.9	999.9	9.9	99.9
2136	1	39	7800	3588	0	3588	390	234	0	355	45.0	4.74	95.0	14.2	1.90	8.9	999.9	99.9	158.0	9.2	7.1
2137	1	50	4800	2208	0	2112	336	144	0	280	4.3	4.82	90.0	14.2	1.40	7.3	999.9	99.9	999.9	9.7	7.3
2138	2	39	5800	4002	0	1450	290	58	0	430	37.4	4.36	86.0	12.4	1.40	10.3	999.9	99.9	999.9	9.2	7.3
2139	2	70	5400	2646	0	1836	216	702	0	310	38.9	4.13	94.0	12.8	2.90	11.7	999.9	99.9	999.9	9.3	7.2
2142	1	40	6900	3726	0	2484	690	0	0	240	49.6	5.30	94.0	16.4	999.99	999.9	999.9	99.9	999.9	9.8	7.1
[redacted]																					
2144	1	42	7600	4788	0	2356	228	228	0	275	47.4	4.63	102.0	15.5	1.30	5.6	999.9	99.9	999.9	99.9	6.7
2145	1	67	7400	3774	74	2516	370	666	0	435	41.3	4.39	94.0	13.6	2.20	6.2	121.0	5.0	149.0	9.4	7.5
2148	1	79	5700	2850	57	2280	285	57	171	185	36.9	4.06	91.0	12.7	2.80	8.4	999.9	99.9	999.9	8.7	6.9
2149	2	43	7200	3024	0	2016	288	2016	0	300	35.2	3.72	95.0	11.8	.10	6.1	999.9	99.9	999.9	9.2	7.2
2150	1	47	8300	5146	0	2075	913	166	0	280	48.2	5.71	84.0	15.8	1.20	2.9	252.0	10.4	250.0	9.1	6.9
2152	1	52	7100	4260	71	2059	426	213	71	365	48.6	5.10	95.0	15.9	4.60	7.4	999.9	99.9	999.9	10.0	8.3
2153	1	36	5000	3400	0	1300	150	150	0	255	41.5	5.09	82.0	13.2	3.10	6.1	204.0	6.6	192.0	9.8	7.7
2155	1	35	11100	5550	0	4995	333	0	222	385	56.4	6.67	85.0	18.7	1.00	6.6	222.0	8.8	221.0	10.0	7.6
2156	1	43	4700	2820	94	1222	376	141	47	370	52.0	5.22	98.0	17.4	.90	7.2	84.0	5.7	999.9	9.2	6.7
2158	2	64	9100	3822	91	4459	728	0	0	380	39.8	4.44	90.0	13.0	1.20	3.1	103.0	99.9	999.9	9.4	7.4

COMPUTER LISTING OF 1989 RAW DATA

PID	SEX	AGE	WBC	PMN	BAND	LYMPH	MONO	EOS	BASO	PLT	HCT	RBC	MCV	HGB	TSH	PRL	FBS	HBA1C	RBS	CAL	TPR
2159	2	40	11700	99999	99999	99999	99999	99999	99999	999	99.9	9.99	999.9	13.8	3.80	999.9	999.9	99.9	999.9	99.9	99.9
2160	2	39	8400	3108	0	3360	420	1344	168	395	44.4	4.88	91.0	15.2	.07	5.3	260.0	6.0	267.0	9.3	7.6
2165	1	46	9500	3800	0	4655	950	190	0	350	45.1	5.20	87.0	14.9	2.40	13.0	107.0	99.9	999.9	9.9	7.7
2166	1	72	11000	5940	110	3410	770	660	110	415	43.6	4.82	90.0	14.6	3.80	6.3	999.9	99.9	999.9	9.6	7.4
2167	1	49	10100	4848	0	4444	808	0	0	240	47.8	5.32	90.0	16.0	.90	9.9	183.0	9.6	273.0	9.6	7.3
2171	2	37	10100	6060	0	3030	303	606	101	270	43.4	4.92	88.0	13.8	0.00	13.3	157.0	5.2	145.0	9.1	7.1
2172	2	47	6600	3696	66	1716	198	792	132	400	46.8	4.94	95.0	14.9	1.70	12.7	278.0	9.1	287.0	9.1	7.0
2174	1	35	9400	5922	0	2726	846	188	94	475	48.8	5.64	87.0	16.3	2.20	6.8	999.9	99.9	999.9	9.3	7.4
2176	1	45	5700	3135	0	2052	342	171	0	360	52.3	5.71	92.0	17.0	1.30	3.4	243.0	11.7	245.0	10.1	7.5
2182	2	87	11000	6050	0	3630	880	330	110	325	33.7	3.64	93.0	11.2	3.90	27.8	999.9	99.9	999.9	10.3	8.1
2188	1	37	5600	3360	112	1344	448	224	112	335	50.9	5.68	90.0	16.2	1.30	4.7	999.9	99.9	345.0	9.6	7.6
2193	2	66	5000	3450	50	1350	100	50	0	380	36.5	3.93	93.0	11.9	2.80	7.8	999.9	99.9	999.9	9.3	99.9
2195	2	59	14300	7007	0	3718	429	3146	0	305	39.6	5.00	79.0	13.5	.30	6.8	179.0	5.4	171.0	9.1	6.8
2196	2	73	6200	3968	124	180	124	186	0	255	38.8	4.49	86.0	12.8	0.00	6.0	105.0	5.9	999.9	99.9	99.9
2197	2	36	7900	5451	0	1659	237	316	237	290	32.3	3.52	92.0	11.2	4.20	26.1	999.9	99.9	999.9	9.6	6.6
2205	1	64	8300	4482	0	3320	83	415	0	310	47.6	5.76	83.0	15.3	.80	8.8	258.0	11.6	256.0	10.1	7.6
2206	1	67	7700	4312	77	2772	308	231	0	335	39.5	4.44	89.0	13.6	.80	9.5	999.9	99.9	999.9	9.2	7.2
2207	1	40	5900	3068	0	2065	295	472	0	235	46.6	5.57	84.0	15.2	1.30	9.4	999.9	99.9	156.0	9.7	7.5
2208	2	72	7500	5400	0	1350	450	225	75	355	39.9	4.54	88.0	13.2	1.60	5.0	159.0	7.9	140.0	9.5	7.2
2209	2	40	7700	5544	0	1386	539	154	77	575	38.3	4.32	89.0	12.5	1.90	9.0	999.9	99.9	999.9	9.7	7.4
2210	2	35	10100	7272	0	2121	303	404	0	330	40.6	4.64	88.0	13.3	1.40	8.8	999.9	99.9	999.9	8.8	7.1
2213	2	36	8100	3564	0	2916	1458	162	0	350	37.6	4.59	82.0	12.4	.10	14.0	999.9	99.9	999.9	9.5	7.1
2215	2	68	9300	6510	0	2325	186	186	93	330	41.6	4.74	88.0	12.9	.03	6.6	153.0	99.9	146.0	9.3	7.4
2217	2	56	7700	4543	0	2002	308	693	154	345	39.4	3.99	99.0	12.4	2.10	9.4	999.9	99.9	999.9	9.8	8.3
2220	2	60	6000	3900	360	1380	300	60	0	325	42.4	4.52	94.0	14.0	3.30	3.7	999.9	99.9	999.9	9.4	8.2
2224	2	66	5900	2714	59	2301	531	295	0	335	35.6	3.73	95.0	11.8	1.40	7.8	999.9	99.9	999.9	9.2	6.9
2225	2	41	7300	4745	0	1825	438	146	73	470	24.7	3.40	73.0	8.5	4.60	17.9	999.9	99.9	999.9	8.8	7.4
2226	2	37	7600	1	0	0	0	0	0	270	39.4	5.11	77.0	13.3	3.10	8.7	999.9	99.9	999.9	99.9	99.9
2227	2	39	12000	9120	0	2280	480	120	0	410	39.0	4.65	84.0	12.2	1.80	13.2	999.9	99.9	999.9	9.0	7.3
2228	2	43	11200	7728	0	2240	336	784	112	255	40.8	4.58	89.0	13.4	2.40	11.7	999.9	99.9	999.9	9.8	7.4
2229	2	53	6900	3933	69	2415	138	138	207	310	42.1	4.80	88.0	13.9	.30	7.7	999.9	99.9	999.9	9.0	6.9
2230	2	47	8000	4960	0	2640	320	80	0	435	47.2	5.57	85.0	14.6	1.30	8.7	247.0	15.0	254.0	10.5	7.4
2231	2	36	8000	4720	0	3040	80	80	80	610	46.4	5.64	82.0	15.2	1.60	5.9	225.0	9.2	223.0	9.8	8.0
2232	1	37	9900	5841	0	3168	792	99	0	315	50.6	5.48	92.0	17.0	3.30	4.9	999.9	99.9	999.9	9.3	7.8
2233	1	36	7900	99999	99999	99999	99999	99999	99999	999	51.1	5.47	93.0	16.8	2.50	3.8	999.9	99.9	218.0	9.4	6.7
2234	1	47	8800	6600	88	1584	264	0	0	390	44.3	5.00	89.0	14.7	2.10	8.9	89.0	99.9	149.0	9.4	8.3
2235	1	42	7300	2628	73	3796	511	219	73	365	46.0	5.01	92.0	14.8	.60	8.1	999.9	99.9	999.9	8.7	7.0
2236	1	46	6500	3315	0	2470	455	260	0	385	47.9	5.83	82.0	15.4	4.80	6.7	999.9	99.9	999.9	10.1	8.3
2237	1	42	6700	2814	0	3350	402	67	67	375	43.7	4.74	92.0	14.6	2.20	5.8	999.9	99.9	999.9	99.9	99.9
2239	2	38	5200	3172	52	1508	208	260	0	340	38.1	4.39	87.0	12.5	.80	7.6	91.0	4.8	999.9	9.0	6.7
2244	2	79	5200	3380	0	1196	312	312	0	260	42.7	4.65	92.0	13.7	2.20	6.4	154.0	6.4	999.9	9.8	8.1
2245	1	35	6700	3886	0	2211	536	0	67	310	48.8	4.98	98.0	15.8	2.10	8.4	999.9	99.9	999.9	8.7	7.0
2247	2	43	6200	4154	0	1240	372	434	0	340	37.8	4.32	88.0	11.9	1.00	8.2	999.9	99.9	999.9	9.2	7.6
2248	2	50	6200	3348	0	1798	496	558	62	320	43.4	5.06	86.0	14.8	45.00	3.7	346.0	13.6	361.0	10.0	8.2
2251	2	39	7800	4602	0	2652	312	234	0	304	38.2	4.84	79.0	13.1	59.40	20.0	999.9	99.9	999.9	99.9	99.9
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]	558	124	420	38.4	4.80	80.0	13.1	4.00	4.7	999.9	99.9	999.9	10.3	7.9
2256	2	40	5300	3021	0	2067	106	53	53	485	34.9	3.90	89.0	11.1	999.99	6.5	252.0	7.0	247.0	9.3	7.1
2257	1	42	5400	3726	0	1296	216	162	0	310	43.6	5.31	82.0	14.2	.80	14.9	999.9	99.9	999.9	9.3	7.3
2260	2	35	6700	3350	0	2479	335	536	0	320	42.9	4.78	90.0	13.9	1.00	53.5	999.9	99.9	999.9	99.9	99.9
2261	1	60	5000	2200	0	2150	300	200	150	310	49.6	5.40	92.0	16.3	2.90	6.8	999.9	99.9	999.9	9.8	8.0
2269	1	34	8300	4814	1	2573	581	166	83	353	49.7	5.41	92.0	16.6	1.50	4.3	999.9	99.9	999.9	10.0	8.4
2271	1	34	8400	3864	0	3360	672	336	168	290	48.5	5.57	87.0	16.4	1.60	4.3	270.0	13.3	275.0	10.1	7.3
2273	1	35	9400	5452	188	2726	282	564	188	394	52.8	6.19	85.0	17.0	999.99	999.9	109.0	4.8	999.9	99.9	99.9
2274	1	34	6500	3055	0	2730	325	65	0	355	47.5	5.78	83.0	15.8	1.50	7.8	999.9	99.9	194.0	9.3	7.5

COMPUTER LISTING OF 1989 RAW DATA

PID	SEX	AGE	WBC	PMN	BAND	LYMPH	MONO	EOS	BASO	PLT	HCT	RBC	MCV	HGB	TSH	PRL	FBS	HBA1C	RBS	CAL	TPR
2277	2	35	8200	4100	0	3198	246	656	0	298	31.6	5.17	61.0	9.8	2.10	14.9	999.9	99.9	999.9	99.9	99.9

COMPUTER LISTING OF 1990 RAW DATA

PID	SEX	AGE	WBC	PMN	BAND	LYMPH	MONO	EOS	BASO	PLT	HCT	RBC	MCV	HGB	TSH	PRL	FBS	HBA1C
2	1	37	7000	3570	0	2520	350	490	70	213	42.3	4.52	94.0	14.8	.20	999.9	999.9	99.9
3	1	37	11300	7232	0	2825	904	0	0	228	36.3	3.94	92.0	12.7	400.00	999.9	999.9	99.9
4	1	74	5700	3480	0	1600	627	2622	342	207	39.6	4.72	84.0	14.0	3.30	999.9	252.0	6.0
5	1	37	12700	10287	0	1651	635	0	127	265	38.0	4.18	91.0	13.5	391.00	999.9	999.9	99.9
6	1	37	8100	4941	0	2754	243	162	0	236	41.9	4.60	91.0	14.8	0.00	999.9	999.9	99.9
7	1	70	6600	3630	0	2442	330	132	66	356	34.4	3.87	31.5	12.2	0.00	999.9	999.9	99.9
8	2	37	11900	8568	0	2380	119	595	238	394	35.9	4.38	82.0	12.7	.10	999.9	999.9	99.9
9	1	56	8400	6132	0	1932	0	168	168	206	38.2	4.21	91.0	13.4	2.30	999.9	95.0	5.1
10	1	59	8000	5760	0	1840	480	0	0	304	43.1	5.24	82.0	14.5	1.80	999.9	347.0	12.2
14	2	60	7500	4125	0	2625	225	525	0	253	33.8	3.61	94.0	12.3	.10	999.9	107.0	99.9
15	2	43	10700	5885	0	3852	214	749	0	328	37.8	4.11	92.0	13.0	6.10	999.9	999.9	99.9
16	1	75	6500	4225	0	1820	260	260	0	283	38.0	5.18	73.0	12.6	5.20	999.9	999.9	99.9
17	2	39	6200	4216	0	1302	496	186	0	278	34.8	4.57	76.0	11.8	0.00	999.9	999.9	99.9
18	2	57	7800	5694	0	1950	156	0	0	291	33.5	3.86	87.0	12.2	0.00	22.2	999.9	99.9
19	1	41	4700	3478	0	1081	94	47	0	229	44.0	5.83	76.0	14.4	14.70	9.3	999.9	99.9
20	1	42	6900	4278	0	1656	207	621	138	297	47.1	5.66	83.0	16.2	1.60	2.7	101.0	5.0
21	2	38	4300	2365	0	1419	43	0	43	251	35.3	4.55	78.0	11.8	26.70	999.9	999.9	99.9
22	2	51	6400	2112	0	2112	448	384	0	253	38.6	4.27	90.0	13.4	2.80	31.0	999.9	99.9
23	1	39	6100	2684	0	2806	366	244	0	275	42.9	4.89	88.0	14.7	8.10	16.1	999.9	99.9
24	2	49	5200	2288	0	2496	208	208	0	236	41.2	4.78	86.2	14.8	.20	4.1	100.0	4.8
27	1	62	7900	3713	0	2686	790	711	79	198	40.8	4.17	98.0	15.0	1.20	2.7	137.0	4.5
33	2	37	6000	2640	0	2460	540	300	60	309	37.8	4.59	82.0	13.1	9.30	4.5	106.0	2.4
34	2	80	6900	3381	69	3243	69	69	69	184	34.3	3.44	100.0	11.8	6.80	12.3	999.9	99.9
36	1	43	8700	6264	0	2001	348	87	0	272	32.4	3.39	96.0	11.6	85.50	5.5	999.9	99.9
37	1	56	5400	3726	0	1296	54	378	0	164	37.5	3.96	95.0	13.6	.80	3.3	999.9	99.9
39	2	50	7200	3816	0	2160	576	576	72	414	38.4	4.26	90.0	12.7	2.90	8.1	999.9	99.9
40	1	65	5600	2184	0	2800	280	280	56	279	36.3	4.11	88.0	12.6	1.40	0.0	84.0	5.4
41	1	77	5400	4158	54	972	108	108	0	158	32.5	3.78	86.0	11.6	6.90	5.3	999.9	99.9
42	2	38	8800	6248	0	1760	352	440	0	252	35.6	3.72	96.0	13.2	0.00	1.7	999.9	99.9
44	1	39	4500	2025	0	2025	405	45	0	237	44.6	5.41	83.0	15.3	2.00	3.0	999.9	99.9
45	2	67	8000	4160	0	2960	80	800	0	321	34.8	3.75	93.0	12.7	.40	8.6	999.9	99.9
47	1	44	7400	4588	0	2146	222	444	0	264	41.0	4.10	100.0	15.1	2.90	3.5	999.9	99.9
48	2	42	5200	3432	0	1560	104	104	0	278	38.9	4.04	96.3	12.9	2.90	999.9	999.9	99.9
49	2	52	5900	3481	0	2124	177	59	59	251	39.5	4.59	86.0	14.2	1.30	4.3	286.0	8.7
53	2	43	6800	3876	0	2176	408	204	136	382	37.7	4.18	90.0	13.5	7.50	6.7	999.9	99.9
61	2	44	7100	99999	99999	99999	99999	99999	99999	304	43.8	4.83	90.7	14.6	38.90	999.9	313.0	99.9
63	2	71	7300	3139	0	3358	438	292	73	218	40.9	4.57	89.0	14.1	2.10	8.8	999.9	99.9
64	2	66	6100	2135	0	3050	244	610	61	220	38.3	4.19	91.0	13.3	0.00	4.5	999.9	99.9
65	2	37	5000	3600	0	850	100	400	50	244	32.6	3.67	89.0	11.2	69.50	29.6	999.9	99.9
66	2	65	5900	1770	0	4130	0	0	0	225	36.7	4.17	88.0	12.7	.70	2.9	96.0	99.9
67	2	49	5500	3410	0	1870	110	110	0	280	36.2	3.86	94.0	12.6	4.10	7.3	999.9	99.9
70	2	52	3500	1435	0	1785	175	105	0	211	33.4	4.01	84.0	12.2	52.90	5.0	999.9	99.9
71	2	62	7500	5325	0	2925	375	375	0	268	42.1	4.63	91.0	14.8	2.90	3.7	999.9	99.9
73	1	54	5300	2756	0	1643	530	371	0	186	45.3	4.72	96.0	15.9	.60	4.4	999.9	99.9
74	2	51	9400	5546	0	3572	188	94	0	277	44.6	5.03	89.0	15.9	2.20	9.7	89.0	4.6
75	2	47	8200	4100	0	3362	246	410	82	246	38.6	4.35	89.0	13.1	9.60	4.9	165.0	7.7
76	1	46	6600	2970	0	3234	198	132	132	188	45.1	4.86	93.0	16.0	2.80	10.8	999.9	99.9
77	1	60	5300	4346	0	742	106	53	0	316	35.2	3.96	89.0	12.2	1.30	2.6	999.9	99.9
78	2	71	5600	2352	0	2688	336	224	0	231	37.8	4.11	92.0	13.4	3.10	4.2	999.9	99.9
79	1	75	4900	2495	147	1666	294	294	0	131	45.2	4.98	90.8	15.2	2.30	999.9	139.0	7.2
81	2	44	5500	2365	0	2310	550	275	0	274	40.6	4.61	88.0	14.3	0.00	4.1	999.9	99.9
86	2	35	6600	4356	0	1386	330	330	198	229	34.2	4.13	83.0	13.0	2.00	6.4	999.9	99.9
805	2	36	7300	3869	0	2190	584	657	0	295	37.3	4.60	81.0	12.6	999.99	999.9	999.9	99.9
811	2	36	7700	3927	0	3542	154	0	77	318	36.3	3.97	92.0	13.4	999.99	999.9	999.9	99.9

COMPUTER LISTING OF 1990 RAW DATA

PID	SEX	AGE	WBC	PMN	BAND	LYMPH	MONO	EOS	BASO	PLT	HCT	RBC	MCV	HGB	TSH	PRL	FBS	HBA1C
816	2	40	6400	4224	0	1664	192	320	0	279	38.4	4.52	85.0	13.1	999.99	999.9	999.9	99.9
820	1	41	8500	4930	0	3060	425	85	0	276	46.3	5.03	92.0	16.0	999.99	999.9	120.0	6.0
822	1	44	5200	3328	0	1404	312	156	0	238	41.3	4.86	85.0	14.3	0.00	0.0	999.9	99.9
823	1	46	5200	2964	0	1768	104	312	52	219	41.1	4.62	90.0	14.8	999.99	999.9	999.9	99.9
825	2	48	7000	3710	0	3010	490	0	0	323	37.8	4.47	85.0	13.1	999.99	999.9	999.9	99.9
826	2	53	4200	2562	0	966	336	294	42	189	33.0	3.78	87.0	11.3	999.99	999.9	999.9	99.9
827	1	49	7100	3834	0	2272	426	568	0	258	39.2	4.40	89.0	13.2	999.99	999.9	100.0	99.9
830	1	51	4200	2688	0	840	210	420	42	220	40.7	4.23	96.0	14.6	999.99	999.9	109.0	99.9
831	1	49	6200	1798	0	3596	558	248	62	241	47.4	5.18	92.0	16.3	999.99	999.9	999.9	99.9
832	2	52	6700	2613	0	3283	201	536	67	239	39.8	4.89	81.0	13.4	999.99	999.9	153.0	8.0
833	1	57	3800	1672	0	1786	228	76	38	247	40.7	4.94	82.0	14.5	999.99	999.9	999.9	99.9
834	1	56	11200	6608	0	3696	672	112	112	236	47.6	5.39	88.0	16.9	999.99	999.9	999.9	99.9
838	1	57	7500	4950	0	1650	525	300	75	215	46.9	5.06	93.0	16.6	999.99	999.9	999.9	99.9
840	1	60	8500	3145	0	3570	510	765	253	333	45.1	5.66	79.7	14.7	999.99	999.9	999.9	99.9
841	2	57	6100	4026	0	1708	183	122	61	222	37.3	4.24	88.0	13.1	1.00	7.4	144.0	6.5
843	2	61	5900	3068	0	1947	118	708	59	220	35.1	3.73	94.0	12.8	.90	4.8	999.9	99.9
844	2	71	10900	7630	0	2725	218	327	0	268	39.8	4.48	89.0	13.4	999.99	999.9	999.9	99.9
845	1	60	6100	2806	0	2623	610	0	61	216	39.4	4.58	86.0	13.3	999.99	8.0	113.0	99.9
851	2	80	6500	4615	99999	1755	65	0	65	212	30.4	3.28	93.0	10.9	999.99	999.9	447.0	9.3
865	2	56	5200	1872	0	2964	312	52	0	277	36.7	3.97	93.0	13.0	999.99	999.9	999.9	99.9
867	2	61	8300	4980	0	2573	581	166	0	222	42.4	4.71	90.0	15.2	1.10	2.7	276.0	8.8
869	1	43	6900	3657	0	2829	276	138	0	268	42.9	4.81	89.0	15.2	999.99	999.9	999.9	99.9
879	2	35	7600	4560	0	2280	456	304	0	262	39.5	4.42	89.0	14.1	999.99	999.9	999.9	99.9
881	1	57	5200	3120	0	1924	104	0	52	165	42.2	4.87	87.0	14.7	999.99	999.9	226.0	9.3
882	1	56	4800	2304	0	2064	192	144	144	217	42.0	5.09	83.0	14.7	999.99	999.9	177.0	7.9
891	2	41	6900	4416	0	1449	276	690	69	341	40.4	4.38	92.0	14.6	999.99	999.9	999.9	99.9
896	2	50	5400	2754	0	1998	270	324	54	264	37.7	4.33	87.0	13.2	999.99	999.9	142.0	6.4
909	2	40	6300	1953	0	3528	504	315	0	261	35.9	3.94	91.0	12.5	999.99	999.9	999.9	99.9
911	2	37	5300	2438	0	2438	212	212	0	284	35.1	3.99	88.0	12.4	999.99	999.9	999.9	99.9
912	1	36	8300	2905	0	4565	249	83	0	271	43.3	5.15	84.0	15.3	999.99	999.9	999.9	99.9
920	1	58	6300	3276	0	2268	441	315	0	212	42.4	4.65	91.0	15.1	999.99	999.9	200.0	6.8
922	2	65	6100	2928	0	2196	366	610	0	302	40.1	4.50	89.0	14.4	999.99	999.9	999.9	99.9
931	1	36	6100	3111	0	2501	183	244	61	237	44.6	4.73	94.0	16.3	999.99	999.9	999.9	99.9
932	2	65	7700	4774	0	2310	154	231	231	286	34.5	4.01	86.0	12.1	999.99	999.9	999.9	99.9
934	2	65	7000	3850	0	2520	420	140	70	307	33.8	4.08	83.0	12.1	999.99	999.9	170.0	5.4
938	2	57	6600	4092	0	1848	396	132	132	220	37.4	4.34	86.0	13.2	1.20	4.7	999.9	99.9
939	1	44	5700	2964	0	2451	57	228	0	255	42.2	4.70	90.0	15.0	999.99	999.9	999.9	99.9
942	2	75	5700	3762	0	1482	171	228	57	275	35.8	4.05	88.0	12.2	1.00	14.0	145.0	7.0
943	1	59	8900	6497	0	1513	534	267	89	327	41.0	4.53	91.0	15.0	.60	999.9	84.0	5.1
944	1	65	6500	3770	0	1495	585	650	0	213	42.5	5.08	84.0	15.1	1.00	999.9	999.9	99.9
955	2	37	7100	3550	0	2414	852	71	0	276	37.5	4.12	91.0	13.4	999.99	2.8	999.9	99.9
958	1	58	7400	4736	0	2294	74	296	0	359	33.0	3.90	85.0	11.3	999.99	999.9	999.9	99.9
959	2	41	5800	2784	0	2378	232	290	116	273	33.9	3.81	89.0	11.9	999.99	999.9	212.0	5.0
960	2	38	9700	5335	0	3402	[illegible]	[illegible]	104	256	39.2	4.51	85.8	13.1	999.99	999.9	999.9	99.9
965	2	46	6800	4488	0	1768	272	272	0	394	34.5	4.00	86.0	11.7	999.99	999.9	[illegible]	[illegible]
966	1	58	6100	4453	0	1098	366	61	122	212	37.6	4.09	92.0	13.0	999.99	999.9	999.9	99.9
971	1	47	7400	4144	0	2738	518	0	0	287	41.5	4.76	87.0	14.5	999.99	999.9	999.9	99.9
977	2	44	6400	2496	0	3328	128	384	64	251	41.0	4.86	84.0	14.7	999.99	999.9	252.0	7.0
980	2	37	8100	4455	0	2754	324	567	0	238	39.5	4.63	85.0	13.8	2.10	999.9	86.0	5.2
981	1	36	6400	3648	0	1536	64	1152	0	193	45.9	4.95	92.8	15.5	999.99	999.9	999.9	99.9
998	2	42	5500	3190	0	2035	55	55	165	246	41.8	4.99	84.0	14.6	999.99	999.9	303.0	10.0
1001	2	56	7000	3710	0	2940	280	0	70	213	40.0	5.06	79.0	14.0	999.99	999.9	999.9	5.9
1007	1	79	5500	3685	0	1485	220	110	0	205	34.5	3.78	91.0	11.9	49.50	999.9	169.0	7.9
1500	1	59	10400	7696	0	1872	624	208	0	267	28.8	3.27	88.0	10.4	999.99	999.9	365.0	6.8

COMPUTER LISTING OF 1990 RAW DATA

PID	SEX	AGE	WBC	PMN	BAND	LYMPH	MONO	EOS	BASO	PLT	HCT	RBC	MCV	HGB	TSH	PRL	FBS	HBA1C
1519	1	47	6200	4588	0	1364	248	0	0	259	45.9	5.18	89.0	16.0	999.99	999.9	142.0	99.9
1520	2	59	6100	3538	0	2379	122	61	0	273	39.5	4.92	80.0	14.4	999.99	999.9	265.0	8.2
1524	1	47	7300	2701	0	4088	365	146	0	215	45.5	5.00	91.0	16.4	999.99	999.9	999.9	99.9
1541	2	62	5700	2508	0	2850	342	57	0	243	37.9	4.34	87.0	13.2	999.99	999.9	999.9	99.9
1542	2	37	10600	7420	0	3074	106	0	0	240	43.0	5.44	79.0	15.4	999.99	999.9	252.0	7.6
1546	1	76	3200	960	0	1856	320	64	0	132	45.5	4.99	91.0	16.2	999.99	999.9	351.0	7.0
1548	2	48	8800	4928	0	3168	440	264	0	257	34.4	3.82	90.0	12.2	999.99	999.9	999.9	99.9
1549	1	37	6300	3402	0	2142	441	315	0	271	41.6	4.78	87.0	14.6	999.99	999.9	999.9	99.9
1553	1	38	6000	2940	0	2880	120	60	0	294	37.1	4.07	91.0	13.6	999.99	999.9	999.9	99.9
1558	2	40	6300	3402	0	2142	189	504	63	287	38.0	4.25	89.0	13.6	1.70	999.9	999.9	99.9
1559	2	37	7800	4836	0	2808	156	0	0	338	42.7	5.38	79.0	14.4	999.99	999.9	999.9	99.9
1563	1	54	4100	1517	0	2501	82	0	41	249	42.6	4.76	90.0	15.3	999.99	999.9	999.9	99.9
1564	2	41	5900	1947	0	3363	177	413	0	282	37.0	4.29	86.0	13.2	1.00	999.9	91.0	9.5
1572	1	42	7600	5472	0	1368	608	76	76	198	48.8	5.77	85.0	17.0	999.99	999.9	999.9	99.9
1577	2	39	9600	6816	0	2016	384	384	0	318	37.3	4.22	88.0	13.5	999.99	999.9	999.9	99.9
2102	1	46	6100	3477	0	2196	366	0	61	300	44.7	4.87	92.0	16.3	999.99	999.9	999.9	99.9
2103	1	79	6500	3705	65	1365	124	130	0	263	35.7	3.91	91.0	13.1	.20	8.0	999.9	99.9
2104	2	59	4800	2544	0	1728	192	336	0	253	37.1	4.09	91.0	13.1	6.20	8.6	150.0	4.6
2105	1	88	9900	5841	0	2475	495	990	99	416	35.7	4.08	87.0	12.7	2.00	10.9	999.9	99.9
2106	1	40	11300	7119	0	3503	113	452	113	268	43.3	5.13	85.0	16.0	1.10	3.9	999.9	99.9
2107	2	61	17200	11696	0	4988	172	344	0	215	35.4	4.14	86.0	12.8	1.80	2.5	106.0	99.9
2108	1	46	5400	2808	0	1998	270	216	108	242	39.5	4.50	88.0	14.5	3.30	11.7	95.0	3.7
2110	1	83	10400	7280	0	2392	728	0	0	292	33.8	3.38	100.0	12.3	3.00	2.5	999.9	99.9
2111	2	39	6500	3835	99999	1625	455	390	130	362	39.3	4.98	79.0	14.0	1.50	6.0	279.0	8.4
2113	2	40	7500	4275	0	2250	600	375	0	325	40.4	5.15	79.0	14.0	2.20	5.7	318.0	8.7
2114	1	76	7600	5320	0	1140	760	304	0	222	39.4	4.63	85.0	14.0	1.40	9.7	294.0	5.2
2117	2	60	6500	3315	0	2730	260	195	0	249	42.6	4.68	91.0	15.3	1.80	3.7	293.0	7.2
2119	2	54	6600	2838	0	3102	198	462	0	332	38.4	4.42	87.0	13.6	.90	3.3	999.9	99.9
2124	1	37	6800	3876	0	1700	612	544	68	225	42.3	4.86	87.0	14.5	2.20	46.4	999.9	99.9
2126	2	44	7000	3920	0	2520	210	420	0	349	37.4	4.36	85.0	12.7	.90	11.4	999.9	99.9
2129	2	53	6700	3886	0	2412	201	134	67	390	33.9	4.49	76.0	12.1	3.60	11.2	394.0	9.8
2130	2	38	7800	5772	0	1794	78	156	0	211	34.7	4.11	85.0	12.1	1.30	32.9	999.9	99.9
2132	2	37	3800	2014	0	1558	114	114	0	240	37.9	4.77	80.0	13.3	0.00	7.5	94.0	8.4
2134	2	36	5900	3127	0	2301	354	118	0	234	40.8	4.67	86.0	14.4	2.60	10.8	999.9	99.9
2136	1	40	5500	2805	0	2145	385	165	0	270	41.4	4.52	92.0	14.3	1.70	7.2	98.0	6.6
2138	2	40	7000	4690	0	1820	210	350	0	376	35.4	4.21	84.0	12.2	1.20	7.9	999.9	99.9
2139	2	71	5900	2950	0	2065	708	177	0	326	35.7	3.87	92.0	12.2	4.20	12.7	999.9	99.9
2142	1	41	6000	3180	0	1980	600	120	120	179	42.3	4.64	91.0	15.3	1.60	4.1	999.9	99.9
2144	1	43	5200	2704	0	1924	416	156	0	257	48.1	5.01	96.0	17.6	2.10	5.0	999.9	99.9
2145	1	68	4900	2646	0	2617	147	147	0	296	40.9	4.33	94.0	14.0	2.50	7.6	116.0	6.9
2148	1	80	6100	2867	0	2257	610	244	122	232	37.8	4.15	91.0	13.5	4.20	4.2	999.9	99.9
2149	2	44	7300	2920	0	3139	365	657	219	297	33.1	3.76	88.0	11.9	1.40	3.5	999.9	99.9
2150	1	48	8400	5292	0	2184	588	336	0	207	47.7	5.75	83.0	16.6	1.10	2.6	296.0	9.8
2152	1	53	5400	3024	0	1836	108	432	0	298	42.6	4.74	90.0	15.6	.20	999.9	999.9	99.9
2153	1	37	5100	3060	0	1632	153	255	0	257	41.0	5.24	78.0	14.1	6.10	999.9	221.0	6.5
2155	1	58	7900	4503	0	2607	553	237	0	273	51.4	5.96	86.0	18.1	.90	999.9	211.0	8.6
2156	1	44	4900	2156	0	1960	392	294	98	209	42.9	4.53	95.0	15.6	1.00	999.9	999.9	99.9
2158	2	65	4200	2184	0	1638	294	42	42	267	37.1	4.30	86.0	13.1	1.00	999.9	999.9	99.9
2160	2	40	5100	2448	0	2091	153	357	51	292	43.8	4.89	90.0	14.8	.20	999.9	301.0	9.2
2166	1	73	5900	3009	0	2124	354	413	0	224	39.3	4.52	87.0	13.8	4.20	999.9	999.9	99.9
2167	1	50	6200	3286	0	2728	186	0	0	225	44.1	5.10	87.0	15.7	.70	999.9	158.0	5.7
2171	2	38	8800	5456	0	2552	704	0	0	282	38.0	4.51	84.0	13.4	.20	999.9	93.0	4.3
2172	2	48	6400	3456	0	2304	448	192	0	280	39.8	4.92	81.0	13.0	2.20	999.9	234.0	10.9
2174	1	36	8500	5695	0	1785	425	510	85	326	46.6	5.32	88.0	16.5	2.00	999.9	999.9	99.9

COMPUTER LISTING OF 1990 RAW DATA

PID	SEX	AGE	WBC	PMN	BAND	LYMPH	MONO	EOS	BASO	PLT	HCT	RBC	MCV	HGB	TSH	PRL	FBS	HBA1C
2176	1	46	5100	2550	0	2295	153	51	51	285	45.0	5.00	90.0	16.0	.90	999.9	251.0	11.1
2182	2	88	5600	3248	56	1848	168	168	112	263	32.4	3.61	90.0	11.5	2.50	24.3	999.9	99.9
2188	1	38	4700	2021	0	2209	470	0	0	162	47.1	5.29	89.0	16.2	1.80	999.9	206.0	9.2
2193	2	67	8000	5760	0	1680	240	320	80	336	31.1	3.47	90.0	10.8	3.50	999.9	999.9	99.9
2195	2	60	6100	2867	0	2196	305	610	122	346	35.0	4.38	80.0	12.5	2.00	999.9	183.0	6.6
2196	2	74	6800	4216	0	2244	68	476	68	287	36.2	4.21	86.0	12.7	0.00	999.9	112.0	4.9
2197	2	37	5500	3355	0	1485	330	330	0	277	34.2	3.95	87.0	11.9	5.30	999.9	999.9	99.9
2205	1	65	7800	3354	0	3276	1014	156	0	264	44.3	5.47	81.0	15.3	.90	999.9	186.0	7.7
2206	1	68	6600	3366	0	1848	396	330	0	293	39.9	4.66	86.0	14.3	.60	999.9	999.9	99.9
2207	1	41	7100	3905	0	2130	213	852	71	254	45.2	5.41	84.0	15.5	2.20	999.9	174.0	5.2
2208	2	73	7300	5110	0	1825	146	219	0	310	40.2	4.55	88.0	14.1	2.80	999.9	221.0	7.4
2209	2	41	7900	4661	0	2370	474	237	158	437	35.3	4.21	84.0	12.4	1.10	999.9	999.9	99.9
2210	2	36	10300	7210	0	2266	412	309	103	315	40.6	4.83	28.6	13.8	1.80	999.9	98.0	99.9
2215	2	69	7600	3344	0	3724	152	380	0	356	42.5	5.04	84.0	14.3	0.00	999.9	165.0	5.1
2217	2	57	7800	4524	0	2574	234	468	0	332	34.8	3.89	89.0	12.6	2.10	999.9	999.9	99.9
2220	2	61	6500	3380	0	2015	195	390	130	294	41.0	4.51	91.0	15.1	4.90	999.9	999.9	99.9
2224	2	67	8600	5590	0	2494	258	258	0	296	32.5	3.54	92.0	11.7	1.70	999.9	999.9	99.9
2225	2	42	7900	5056	0	2054	553	237	0	328	34.7	4.34	80.0	11.8	6.10	999.9	999.9	99.9
2226	2	38	5300	2597	0	2385	265	0	53	374	38.1	5.05	75.5	12.0	3.10	999.9	999.9	99.9
2227	2	40	7800	4680	0	2418	312	390	0	379	30.4	4.12	74.0	10.4	2.70	999.9	999.9	99.9
2228	2	44	12900	8643	0	3741	387	0	129	352	40.1	4.67	86.0	14.1	2.20	999.9	999.9	99.9
2229	2	54	6400	3264	0	2688	384	64	0	311	40.6	4.70	86.4	14.4	0.00	999.9	999.9	99.9
2230	2	48	8300	5810	0	2075	249	166	0	324	40.8	5.01	82.0	14.1	1.00	999.9	227.0	6.8
2231	2	37	5000	1950	0	2450	250	200	100	413	42.5	5.26	81.0	14.7	1.40	999.9	284.0	8.4
2232	1	38	9700	5723	0	2910	873	97	97	247	49.8	5.28	94.0	17.9	3.00	999.9	94.0	5.6
2233	1	37	7000	3780	0	2310	560	350	0	310	48.7	5.39	90.0	17.5	2.50	999.9	114.0	4.1
2234	1	48	6100	3538	0	2074	366	61	0	259	43.6	5.03	87.0	15.7	4.00	999.9	87.0	3.9
2235	1	43	7300	4307	0	2482	146	365	0	290	40.4	4.59	88.0	14.8	1.50	999.9	999.9	99.9
2236	1	47	5700	3078	0	2280	342	0	0	307	43.7	5.36	82.0	15.4	5.40	999.9	999.9	99.9
2239	2	39	8400	5880	0	1764	168	588	0	342	36.8	4.25	87.0	13.0	0.00	999.9	999.9	99.9
2242	1	36	99999	99999	99999	99999	99999	99999	99999	999	99.9	9.99	999.9	99.9	1.80	7.0	999.9	99.9
2244	2	80	3600	1908	0	1476	108	72	36	218	35.4	3.73	95.0	12.3	2.20	999.9	150.0	5.6
2247	2	44	10900	6867	0	2398	654	981	0	338	35.4	4.19	85.0	12.6	1.00	999.9	999.9	99.9
2248	2	51	9200	5520	0	2392	184	1104	0	377	39.9	4.85	82.0	13.8	6.20	999.9	311.0	10.1
2251	2	41	7400	4366	0	2294	74	444	222	354	37.6	4.96	76.0	13.0	.10	999.9	999.9	99.9
2254	2	41	6000	3240	0	2100	120	480	0	344	38.1	4.66	81.7	12.4	4.00	999.9	999.9	99.9
2255	2	35	99999	99999	99999	99999	99999	99999	99999	999	99.9	9.99	999.9	99.9	1.60	999.9	999.9	99.9
2256	2	41	7100	3550	0	2982	355	71	142	481	29.9	3.50	85.0	10.6	1.20	999.9	294.0	8.3
2257	1	43	5500	3465	0	1760	220	0	55	257	43.5	5.33	82.0	15.1	1.30	999.9	999.9	99.9
2260	2	36	8800	3432	0	4224	880	176	88	377	38.9	4.63	84.0	14.1	.80	60.0	999.9	99.9
2261	1	61	4500	99999	99999	99999	99999	99999	99999	226	45.3	4.94	92.0	16.2	3.40	999.9	999.9	99.9
2269	1	35	7700	5005	0	2156	308	231	0	300	46.3	5.12	91.0	16.6	2.00	999.9	999.9	99.9
2271	1	35	6200	3286	0	1984	620	124	186	292	45.3	5.21	87.0	16.4	2.20	2.4	269.0	7.5
2273	1	35	9500	5700	0	2850	570	380	0	288	47.3	5.68	83.0	16.9	2.00	999.9	110.0	5.2
2274	1	35	5000	1700	0	2800	400	100	0	257	45.0	5.32	83.0	15.7	[illegible]	999.9	121.0	5.8
2277	2	35	11200	8400	0	2352	0	336	112	368	31.9	5.25	61.0	9.5	1.30	999.9	999.9	99.9

COMPUTER LISTING OF 1991 RAW DATA

PID	SEX	AGE	WBC	PMN	BAND	LYMPH	MONO	EOS	BASO	PLT	HCT	RBC	MCV	HGB	TSH	PRL	FBS	HBA1C
2	1	38	7400	4958	0	1406	370	666	0	226	41.0	4.36	94.0	14.7	.20	999.9	999.9	99.9
3	1	38	8500	4505	0	3230	340	340	85	231	40.0	4.50	89.0	13.5	206.00	999.9	999.9	99.9
5	1	38	8900	6764	0	1246	89	712	89	261	39.9	4.24	94.0	13.7	17.80	999.9	999.9	99.9
6	1	38	5800	2552	0	2552	522	174	58	238	44.8	4.78	93.8	15.6	0.00	999.9	999.9	99.9
7	1	71	6300	2394	0	3024	252	630	0	327	37.5	4.15	90.4	13.0	0.00	999.9	999.9	99.9
8	2	38	8900	4984	0	2848	0	890	178	370	39.8	4.50	88.5	13.7	.80	0.0	999.9	99.9
9	1	57	8500	5525	0	2465	425	85	0	228	42.7	4.63	92.2	14.6	1.60	999.9	999.9	6.2
10	1	60	6400	3968	0	2048	256	128	0	281	43.6	5.34	81.7	14.2	2.30	999.9	241.0	9.7
12	2	53	99999	99999	99999	99999	99999	99999	99999	999	99.9	9.99	999.9	99.9	3.00	0.0	999.9	99.9
14	2	61	7900	4266	0	2923	237	395	79	267	36.1	3.80	95.1	12.8	2.30	999.9	999.9	99.9
15	2	44	8900	3827	0	4361	356	356	0	367	38.3	4.17	91.8	12.8	5.80	999.9	999.9	99.9
16	1	76	5600	1904	56	1680	280	1624	56	219	37.5	5.01	74.9	11.9	8.90	999.9	999.9	99.9
17	2	40	6200	3224	0	2356	310	310	0	254	37.9	4.39	86.4	13.1	.20	999.9	999.9	99.9
18	2	58	7900	4345	0	2765	79	553	158	296	36.5	4.14	88.1	12.7	18.10	999.9	84.0	99.9
19	1	42	4700	3008	0	940	470	235	0	287	46.5	6.22	74.8	14.3	0.00	999.9	999.9	99.9
20	1	43	6700	3886	0	1206	402	1206	0	237	48.0	5.74	83.7	16.2	.20	999.9	86.0	5.5
21	2	40	4600	2806	0	99999	184	460	138	263	37.6	4.50	83.0	12.4	0.00	999.9	999.9	99.9
22	2	52	4300	1892	0	1935	215	215	43	252	38.7	4.34	89.2	12.7	0.00	999.9	122.0	4.1
24	2	50	5800	3016	0	2204	406	174	0	255	40.0	4.70	85.2	14.0	0.00	999.9	999.9	8.4
27	1	63	5800	3306	0	2146	58	174	116	311	37.8	3.87	97.7	13.8	0.00	999.9	999.9	99.9
33	2	38	99999	99999	99999	99999	99999	99999	99999	999	99.9	9.99	999.9	99.9	3.30	999.9	999.9	99.9
34	2	81	10800	7452	0	2484	216	540	0	196	33.4	3.33	100.4	11.5	999.99	999.9	999.9	99.9
36	1	44	6600	4686	0	1386	462	0	66	218	39.0	4.12	94.4	13.0	140.00	999.9	999.9	99.9
37	1	57	4700	2397	0	1880	47	376	0	207	37.4	4.00	93.5	13.1	1.00	999.9	999.9	99.9
39	2	51	9300	4092	0	3255	744	1116	0	493	37.6	4.17	90.2	13.0	3.10	999.9	999.9	99.9
40	1	66	4800	1776	0	2400	192	480	48	271	37.6	4.14	90.9	12.5	1.50	999.9	999.9	99.9
41	1	78	5700	2736	57	2223	57	627	0	170	36.3	4.01	90.5	12.6	5.00	999.9	999.9	99.9
42	2	39	8400	6132	0	1512	588	168	0	219	36.9	3.77	97.8	13.4	.20	999.9	999.9	99.9
44	1	40	5900	3363	0	2124	295	118	0	250	45.5	5.45	83.4	15.5	2.30	999.9	999.9	99.9
45	2	68	5500	3190	0	1430	440	385	55	401	33.0	3.54	93.1	11.4	.50	999.9	999.9	99.9
48	2	42	5400	3348	0	1458	270	270	54	269	37.3	3.96	94.3	13.1	3.60	999.9	999.9	99.9
49	2	53	6300	2709	0	2961	441	126	63	275	41.0	4.68	87.6	13.8	1.50	999.9	234.0	11.4
53	2	44	7000	3220	0	3360	280	140	0	406	39.8	4.48	88.8	13.7	4.50	999.9	999.9	99.9
61	2	45	7600	99999	99999	99999	99999	99999	99999	999	39.8	4.33	92.0	12.7	999.99	999.9	432.0	9.9
63	2	72	5500	2530	0	2255	385	330	0	209	39.6	4.50	88.1	13.5	2.60	999.9	999.9	99.9
64	2	67	6200	2294	62	3410	186	248	62	252	36.1	3.92	92.0	12.0	187.00	999.9	102.0	4.7
65	2	38	5500	4235	0	715	275	275	0	246	23.4	2.47	94.8	7.8	161.00	999.9	999.9	99.9
66	2	66	7700	2772	154	4081	539	154	0	314	37.3	4.20	88.8	13.0	0.00	999.9	999.9	99.9
67	2	50	5000	2450	0	2200	50	250	0	308	35.3	3.75	94.0	12.2	11.10	999.9	999.9	99.9
70	2	53	4800	2160	0	2496	48	48	48	243	36.0	4.39	82.1	12.9	55.90	999.9	999.9	99.9
71	2	63	7000	3780	0	2870	0	350	0	257	37.8	4.18	90.4	13.2	4.50	999.9	999.9	99.9
72	2	44	4600	2254	0	1748	322	276	0	405	34.9	4.06	86.0	11.4	115.00	999.9	999.9	99.9
73	1	55	4700	2914	0	1269	188	282	47	185	46.4	4.94	94.0	15.9	.40	999.9	999.9	99.9
74	2	52	13700	7261	0	4795	822	822	0	298	46.9	5.28	88.9	16.2	8.80	999.9	999.9	99.9
75	2	48	9400	3196	0	4888	188	940	188	337	38.5	4.35	88.4	12.8	10.70	999.9	999.9	99.9
[redacted]																		
77	1	61	8200	6068	0	1312	656	164	0	299	40.9	4.62	88.5	13.6	.30	999.9	999.9	99.9
78	2	72	7800	4056	0	3432	156	156	0	250	36.4	3.95	92.1	12.9	2.30	999.9	999.9	9.3
79	1	76	5100	1785	51	2958	204	51	51	128	46.6	5.16	90.3	16.3	2.70	999.9	136.0	99.9
83	1	36	6200	2666	0	2480	372	620	62	165	45.1	4.62	97.7	16.0	1.70	13.2	999.9	99.9
86	2	36	6900	4140	0	1725	966	207	138	295	38.6	4.57	84.4	13.5	3.10	999.9	999.9	99.9
805	2	37	7900	2133	79	3081	316	2212	79	360	38.5	4.68	82.2	12.5	999.99	999.9	999.9	99.9
811	2	37	8500	3145	85	4420	425	425	0	192	38.1	4.14	92.0	13.6	999.99	2.4	88.0	99.9
816	2	41	7100	5254	0	1278	71	426	71	309	39.0	4.55	85.7	13.1	999.99	17.5	999.9	99.9

COMPUTER LISTING OF 1991 RAW DATA

PID	SEX	AGE	WBC	PMN	BAND	LYMPH	MONO	EOS	BASO	PLT	HCT	RBC	MCV	HGB	TSH	PRL	FBS	HBA1C
822	1	45	5400	3132	0	1674	108	378	108	270	44.8	5.07	88.3	14.9	.70	999.9	999.9	99.9
823	1	47	4100	1599	0	2050	82	328	41	213	42.9	4.82	89.1	14.9	999.99	999.9	999.9	99.9
825	2	49	5300	2915	53	1855	318	106	53	347	38.2	4.48	85.3	12.9	999.99	999.9	999.9	99.9
826	2	54	4900	2597	49	1323	392	490	49	220	33.8	3.88	87.0	11.3	4.50	999.9	999.9	99.9
827	1	50	7700	4158	77	2387	154	924	0	307	39.4	4.58	86.0	12.4	999.99	999.9	100.0	5.1
830	1	52	5200	2964	0	1248	208	624	156	273	39.6	4.04	98.0	13.6	999.99	999.9	999.9	99.9
831	1	50	5600	2016	0	2520	448	504	112	257	46.1	5.03	91.7	15.4	999.99	999.9	999.9	99.9
832	2	53	6000	3360	0	2400	180	60	0	232	40.0	4.97	80.5	13.2	999.99	999.9	172.0	7.9
833	1	58	3700	1739	0	1665	148	74	74	265	42.9	5.18	82.8	14.8	1.30	999.9	999.9	99.9
834	1	57	10600	6148	106	3710	318	212	106	252	44.5	5.15	86.4	15.5	999.99	999.9	999.9	99.9
835	2	57	8000	2880	0	4480	240	400	0	281	42.1	4.61	91.3	15.0	999.99	999.9	203.0	6.3
838	1	58	8400	4788	0	2604	756	168	84	252	51.9	5.63	92.2	17.4	999.99	999.9	999.9	99.9
840	1	61	8700	4176	0	2523	609	1392	0	350	47.0	5.93	79.3	15.8	2.00	4.1	999.9	99.9
841	2	58	4800	2064	0	1968	288	432	48	228	36.2	4.10	88.3	11.9	1.00	999.9	6.7	6.7
843	2	62	9500	4275	0	4180	95	950	0	261	41.4	4.44	93.3	14.7	999.99	999.9	999.9	99.9
844	2	72	5500	2420	0	2585	275	220	0	221	37.1	4.10	90.4	12.4	999.99	999.9	999.9	99.9
845	1	61	6000	2640	0	2820	360	60	120	238	39.9	4.67	85.4	13.2	999.99	999.9	999.9	99.9
851	2	81	5600	2464	0	2016	112	1008	0	179	33.9	3.70	91.7	12.4	999.99	999.9	207.0	11.5
865	2	58	5500	1760	55	3080	110	495	0	999	38.8	4.29	90.0	13.2	999.99	999.9	95.0	5.2
867	2	62	9000	4950	0	3330	270	360	90	292	39.6	4.39	90.3	14.1	.50	999.9	999.9	9.7
881	1	58	5200	2028	52	2912	104	52	52	179	45.0	5.26	85.6	15.3	999.99	999.9	187.0	10.3
882	1	58	5100	99999	99999	99999	99999	99999	99999	424	41.8	5.00	82.2	14.2	999.99	999.9	119.0	10.0
883	1	79	7500	3075	0	3150	300	825	150	239	39.6	4.00	99.0	13.6	5.30	999.9	999.9	99.9
888	2	62	6000	3300	0	2340	60	240	60	259	36.7	4.14	88.7	12.6	1.00	999.9	999.9	4.4
896	2	51	7400	3034	0	4070	148	148	0	270	41.1	4.70	87.4	14.3	999.99	999.9	126.0	6.7
911	2	38	4700	2538	0	1786	188	141	47	321	37.3	4.20	88.7	12.8	999.99	14.1	999.9	99.9
914	2	56	7500	3750	0	3075	225	450	0	271	33.7	3.96	85.0	11.8	999.99	999.9	999.9	99.9
920	1	59	8500	4760	0	2465	510	595	170	199	40.4	4.39	92.0	14.0	999.99	999.9	145.0	7.0
932	2	66	7000	3010	0	2870	280	840	0	264	32.8	3.65	89.9	11.3	999.99	999.9	999.9	99.9
938	2	58	6800	3128	0	2584	340	544	204	186	38.6	4.43	87.1	13.2	1.90	999.9	999.9	99.9
939	1	45	6100	1769	0	2684	244	1281	122	261	44.3	5.17	85.7	15.1	999.99	999.9	151.0	7.8
942	2	76	5000	1850	100	2950	0	50	50	251	34.7	3.75	92.4	11.8	39.70	999.9	165.0	6.9
944	1	66	7700	3465	0	1925	385	1771	154	210	47.3	5.58	84.8	16.2	0.00	999.9	156.0	7.9
955	2	38	10000	6500	100	2500	400	0	0	358	38.5	4.33	89.0	12.9	999.99	999.9	999.9	99.9
959	2	42	6500	3250	0	1755	130	455	0	288	40.0	4.63	86.5	13.5	1.80	999.9	337.0	14.0
960	2	39	10000	5900	100	3400	100	200	300	308	36.9	4.31	85.5	12.5	999.99	7.3	999.9	99.9
963	1	63	5300	2279	53	2385	159	371	53	239	41.9	4.76	88.1	14.0	2.20	4.9	999.9	99.9
965	2	47	8000	4880	0	2240	320	400	80	387	38.4	4.47	86.0	12.6	2.10	999.9	999.9	99.9
971	1	48	6700	3484	0	3082	67	67	0	310	43.4	5.00	86.8	14.9	999.99	999.9	999.9	99.9
977	2	45	10600	7632	106	1802	424	530	106	323	35.6	4.15	85.7	12.3	999.99	11.6	206.0	8.4
980	2	38	6600	3960	0	2046	264	330	0	242	40.7	4.68	86.9	13.4	1.30	13.9	999.9	99.9
981	1	37	7200	5112	0	1368	144	432	144	198	43.4	4.79	90.7	15.1	.90	999.9	999.9	99.9
993	2	44	[illegible]	[illegible]	0	2464	504	392	56	225	40.8	4.71	86.7	13.6	999.99	10.5	999.9	99.9
998	2	44	6500	4615	0	2130	71	284	0	253	39.7	[illegible]	85.4	14.1	999.99	999.9	263.0	9.2
1001	2	57	7100	3266	0	3124	355	284	71	238	38.4	4.83	79.6	13.1	999.99	999.9	999.9	99.9
1007	1	80	4500	2025	0	2115	180	180	0	198	34.9	3.98	87.6	12.0	9.40	9.3	193.0	10.0
1043	2	56	7800	6240	0	1404	156	0	0	316	40.7	4.84	84.0	13.8	999.99	999.9	999.9	4.5
1519	1	48	7900	5530	0	1580	474	316	0	281	48.5	5.40	89.8	16.4	999.99	999.9	999.9	4.1
1520	2	60	5100	2448	0	2193	306	102	51	267	40.0	4.97	80.5	14.0	999.99	999.9	135.0	7.5
1524	1	48	8100	2511	0	5103	243	162	81	231	47.0	5.15	91.3	16.4	999.99	999.9	999.9	99.9
1525	2	48	6200	2666	0	2170	372	992	0	336	37.0	4.17	88.7	12.5	999.99	999.9	999.9	99.9
1541	2	63	7600	4788	0	2432	304	76	0	266	37.5	4.30	87.1	12.7	999.99	999.9	999.9	99.9
1546	1	77	6700	3484	0	2680	469	67	0	113	47.9	5.25	91.2	16.4	999.99	999.9	999.9	9.3
1548	2	49	9000	7020	0	1530	360	0	90	291	32.7	3.61	90.6	11.2	999.99	999.9	999.9	6.4

COMPUTER LISTING OF 1991 RAW DATA

PID	SEX	AGE	WBC	PMN	BAND	LYMPH	MONO	EOS	BASO	PLT	HCT	RBC	MCV	HGB	TSH	PRL	FBS	HBA1C
1549	1	38	6200	3100	0	2604	186	248	62	306	43.1	5.00	86.1	14.3	999.99	999.9	999.9	99.9
1552	1	61	5800	3364	0	1914	232	232	0	298	43.5	5.02	86.7	14.0	999.99	4.3	999.9	99.9
1553	1	39	5800	2958	0	1972	348	290	174	371	42.5	4.56	93.2	14.6	999.99	999.9	999.9	99.9
1558	2	41	5600	2184	0	2296	224	616	280	325	39.2	4.41	88.8	13.5	2.20	999.9	999.9	99.9
1559	2	38	7500	4275	0	2400	675	150	0	360	42.5	5.25	80.9	14.0	999.99	23.9	999.9	99.9
1560	2	67	7500	3375	150	3675	150	75	75	195	39.6	4.19	94.5	13.7	999.99	8.3	999.9	9.1
1563	1	55	4500	2115	0	2115	180	90	0	279	43.3	4.85	89.2	15.4	999.99	2.9	85.0	4.4
1564	2	42	8700	4524	0	2436	522	1044	174	274	38.4	4.46	86.2	13.0	1.80	999.9	999.9	99.9
1567	2	37	4000	1760	0	1680	240	200	120	338	32.7	3.78	86.6	10.9	999.99	999.9	999.9	99.9
1572	1	43	6400	3776	0	2112	384	0	128	206	48.2	5.69	84.7	16.3	999.99	999.9	999.9	99.9
1573	1	41	6000	2460	0	2700	480	240	120	197	49.1	5.32	92.3	16.6	3.30	999.9	999.9	99.9
1577	2	40	11700	5733	0	3276	585	2106	0	371	38.3	4.27	89.8	13.5	999.99	999.9	999.9	99.9
2102	1	47	8300	4814	0	2739	415	166	166	370	46.7	5.00	93.3	16.8	2.00	8.9	101.0	99.9
2103	1	80	5100	2703	51	1887	102	255	0	297	35.8	3.82	93.6	12.6	.70	999.9	106.0	99.9
2104	2	60	6200	4030	0	1426	248	434	62	274	35.6	3.89	91.5	12.3	4.50	999.9	161.0	4.2
2105	1	89	10000	5500	0	2800	500	1200	0	407	38.1	4.37	87.1	30.2	1.60	999.9	999.9	99.9
2106	1	41	11800	7080	236	3540	354	472	118	274	45.5	5.48	83.1	17.1	1.50	999.9	99.0	5.5
2107	2	62	12400	5952	0	4216	1240	620	248	250	39.3	4.59	85.6	13.7	1.60	999.9	144.0	4.9
2108	1	47	5100	3621	255	816	51	255	102	269	43.0	4.93	87.2	15.5	2.50	999.9	999.9	5.3
2110	1	84	5600	3304	0	1792	392	56	56	392	35.6	3.30	108.0	11.9	999.99	999.9	999.9	99.9
2111	2	40	9000	6300	0	1710	720	270	0	374	37.8	4.71	80.3	13.5	1.50	999.9	189.0	5.9
2113	2	41	7600	4788	0	2052	380	304	76	362	36.6	4.69	78.0	12.6	2.30	999.9	298.0	10.8
2114	1	77	7500	4725	0	1875	300	525	75	249	39.7	4.60	86.3	13.5	1.50	999.9	282.0	10.7
2115	1	37	8800	99999	99999	99999	99999	99999	99999	999	53.2	6.01	89.0	17.1	2.00	4.1	86.0	5.6
2117	2	61	8200	4510	0	2460	246	656	328	288	42.2	4.75	88.9	14.8	3.20	999.9	999.9	9.7
2119	2	55	5800	3132	58	1740	290	464	116	313	39.2	4.51	86.9	13.5	1.10	999.9	999.9	99.9
2124	1	38	7900	4503	0	2844	474	79	0	292	41.3	4.64	89.1	14.3	2.60	8.8	999.9	99.9
2126	2	45	7500	3975	0	3000	75	450	0	385	39.7	4.66	85.2	13.3	1.60	999.9	999.9	99.9
2130	2	39	8100	4698	0	1863	486	972	81	210	37.2	4.31	86.2	12.6	2.20	999.9	999.9	99.9
2132	2	38	4600	2622	0	1518	184	184	92	232	38.4	4.61	83.3	13.2	1.80	999.9	999.9	99.9
2134	2	37	6700	3953	0	2211	268	201	67	287	42.8	5.03	85.0	14.7	2.30	999.9	999.9	99.9
2136	1	41	6600	3828	0	1782	198	792	0	340	41.4	4.50	92.0	14.0	1.90	999.9	999.9	99.9
2138	2	41	7700	4466	0	1925	539	616	154	449	37.2	4.38	85.0	12.6	1.00	999.9	999.9	99.9
2139	2	72	4500	2250	0	1620	405	225	0	310	34.5	3.74	92.3	11.5	4.80	999.9	999.9	99.9
2142	1	42	8300	5063	83	2656	415	83	0	172	44.1	4.83	91.4	16.1	1.00	999.9	999.9	99.9
2143	1	39	7200	5472	0	1368	288	72	0	328	42.0	5.13	81.9	13.8	3.90	999.9	999.9	99.9
2144	1	44	5300	2491	0	2014	742	53	0	243	52.2	5.51	94.8	18.1	1.70	999.9	999.9	99.9
2145	1	69	4900	2254	0	2058	147	343	98	297	41.3	4.41	93.6	13.8	2.80	999.9	999.9	99.9
2147	2	42	5500	3080	0	2310	110	0	0	367	32.1	3.88	82.7	11.2	2.90	5.5	999.9	99.9
2148	1	81	4900	2499	49	1911	343	98	0	277	33.9	3.72	91.0	12.0	4.00	999.9	999.9	99.9
2149	2	45	6700	4087	0	1675	67	737	134	302	33.9	3.85	88.0	11.8	2.30	999.9	999.9	99.9
2150	1	49	6900	3657	0	2553	276	414	0	243	50.0	5.93	84.3	17.2	1.20	999.9	332.0	6.5
2152	1	54	4800	2256	96	1776	48	480	144	277	43.6	4.80	90.8	15.3	2.20	999.9	999.9	99.9
2155	1	37	6800	3332	0	2720	272	476	0	281	51.3	5.93	86.3	17.3	1.30	999.9	209.0	9.7
2156	1	45	10400	7904	208	1560	416	208	104	230	44.1	4.81	91.6	15.5	.70	999.9	999.9	99.9
2158	2	66	5500	2365	110	2420	385	110	110	308	40.2	4.60	87.3	13.6	1.00	999.9	105.0	5.0
2160	2	41	6400	3776	0	2112	320	192	0	288	41.2	4.66	88.5	14.0	1.30	999.9	255.0	8.6
2162	2	69	10300	7004	0	2266	515	515	0	303	36.3	4.43	81.9	11.8	2.50	999.9	999.9	99.9
2166	1	75	5200	1456	0	3224	312	156	52	999	39.3	4.76	83.0	13.6	3.90	4.6	999.9	99.9
2167	1	51	6500	2925	0	2600	325	520	130	227	43.0	4.94	87.0	15.4	.20	999.9	999.9	99.9
2171	2	39	8900	4895	0	1780	0	2047	178	313	39.1	4.55	86.0	13.1	4.80	999.9	999.9	99.9
2172	2	49	5800	3364	58	1740	406	174	58	241	42.6	4.83	88.3	14.3	2.10	999.9	328.0	11.1
2174	1	37	8400	4536	0	2856	588	168	168	349	46.2	5.37	86.1	16.3	1.60	999.9	999.9	99.9
2176	1	47	5500	2365	0	2145	495	495	0	258	47.0	4.97	94.5	16.1	1.30	999.9	249.0	10.1

COMPUTER LISTING OF 1991 RAW DATA

PID	SEX	AGE	WBC	PMN	BAND	LYMPH	MONO	EOS	BASO	PLT	HCT	RBC	MCV	HGB	TSH	PRL	FBS	HBA1C
2179	1	40	7500	3900	0	3000	375	225	0	291	50.2	6.10	82.3	17.0	1.10	9.8	999.9	5.7
2182	2	89	4100	2501	0	1189	164	246	0	307	31.9	3.55	89.8	11.1	2.30	999.9	999.9	99.9
2188	1	39	4700	2726	0	1504	282	188	0	172	48.6	5.50	88.3	16.1	1.40	999.9	182.0	6.2
2193	2	68	5200	3172	0	988	156	832	52	249	32.4	3.60	90.1	11.3	2.80	999.9	999.9	99.9
2195	2	61	6200	2852	0	2108	372	806	62	297	36.1	4.57	79.1	12.6	1.90	999.9	242.0	7.8
2196	2	75	8200	3608	0	3526	246	820	0	379	36.5	4.23	86.4	12.5	0.00	999.9	107.0	4.8
2197	2	39	5200	3120	0	1820	260	0	0	999	37.1	4.09	91.0	12.2	6.90	24.7	999.9	99.9
2205	1	66	6700	2680	0	2948	603	469	0	260	44.4	5.38	82.5	14.7	1.00	999.9	999.9	6.6
2206	1	69	5900	2773	59	1947	295	767	59	268	40.0	4.52	88.4	13.9	.60	999.9	999.9	99.9
2207	1	42	6400	2624	128	2624	384	576	64	237	44.6	5.38	82.9	14.9	1.30	999.9	232.0	99.9
2208	2	74	8900	6497	0	1691	267	445	0	380	41.4	4.77	86.8	14.6	3.60	999.9	999.9	8.5
2209	2	42	7400	5920	0	1110	74	148	148	459	34.5	4.07	84.7	12.3	1.20	999.9	999.9	99.9
2210	2	37	7500	4200	0	1950	375	975	0	428	40.2	4.87	82.6	13.6	1.20	999.9	95.0	6.8
2215	2	70	8300	3901	83	3403	166	747	0	414	37.5	4.39	85.5	12.5	1.30	999.9	163.0	99.9
2216	2	71	12000	7920	0	3360	600	120	0	554	40.1	4.84	82.9	13.5	2.20	19.3	999.9	99.9
2217	2	58	6100	3660	0	1891	244	305	0	271	35.9	3.97	90.5	12.4	2.30	999.9	999.9	99.9
2220	2	62	6800	4556	68	1836	68	204	68	278	38.9	4.32	90.0	13.6	6.50	999.9	76.0	4.7
2221	2	89	4700	2209	47	1833	423	188	0	170	29.2	3.00	97.3	10.2	11.30	20.3	999.9	99.9
2224	2	68	6800	4148	0	1564	68	1020	0	274	33.4	3.61	92.4	11.5	1.80	999.9	999.9	99.9
2225	2	43	9100	5187	0	2730	91	910	91	348	36.3	4.44	81.8	11.8	5.30	999.9	999.9	99.9
2227	2	41	7500	4875	0	2100	225	300	0	416	35.1	4.62	75.9	11.4	2.60	999.9	999.9	99.9
2228	2	45	12700	6985	0	2921	635	1905	254	405	39.1	4.57	85.6	13.4	1.70	999.9	999.9	99.9
2229	2	55	7300	4015	0	2409	511	292	73	287	41.6	4.76	87.4	14.5	.90	999.9	999.9	5.3
2230	2	49	7800	5148	78	1872	546	156	0	330	44.0	5.37	82.0	14.6	.90	999.9	253.0	8.8
2231	2	38	5800	3770	0	1798	174	58	0	468	39.7	4.93	80.5	13.7	.90	999.9	999.9	9.8
2232	1	39	7000	2940	0	3290	280	490	0	237	52.5	5.57	94.2	18.7	4.20	6.1	999.9	99.9
2233	1	38	6300	2835	0	2583	0	882	0	247	46.4	5.00	92.7	15.7	2.60	999.9	999.9	5.4
2235	1	44	6600	3894	0	1650	594	330	132	285	41.3	4.71	87.6	14.9	.70	999.9	90.0	4.5
2236	1	48	9100	6734	0	1638	546	182	0	999	41.9	5.06	82.9	14.3	5.10	999.9	999.9	99.9
2237	1	44	6300	3969	63	1701	441	189	0	390	44.8	5.02	89.2	15.5	2.20	999.9	90.0	99.9
2239	2	40	7400	4366	0	1850	370	666	74	372	39.2	4.52	86.7	13.5	4.00	999.9	999.9	99.9
2244	2	81	3700	1110	37	2109	222	222	0	239	33.5	3.55	94.3	11.2	2.20	999.9	111.0	4.7
2247	2	45	8000	4000	80	2720	640	560	0	317	35.1	4.36	80.6	11.5	.90	999.9	999.9	99.9
2248	2	52	8300	4814	0	2324	332	747	83	303	38.9	4.63	84.1	13.0	26.50	999.9	120.0	7.6
2251	2	42	10500	6720	0	2835	525	420	0	482	36.9	4.55	81.1	12.2	115.00	999.9	999.9	99.9
2254	2	41	4800	2496	0	1536	192	576	0	351	38.3	4.80	79.7	12.5	4.60	999.9	999.9	99.9
2256	2	42	5500	3465	0	1540	275	220	0	424	31.3	3.76	83.2	11.2	1.50	999.9	424.0	9.3
2257	1	44	7200	4752	0	1872	504	0	72	265	44.2	5.44	81.2	14.7	.80	7.6	999.9	99.9
2260	2	37	7800	2964	0	3666	312	780	78	389	41.3	4.84	85.3	14.5	1.20	57.8	999.9	99.9
2261	1	62	5000	3000	50	1500	200	250	0	212	49.6	5.43	91.4	17.5	3.20	999.9	999.9	99.9
2269	1	36	7700	3465	0	2772	308	1078	77	299	46.3	5.09	91.0	16.8	2.50	999.9	999.9	99.9
2271	1	36	6000	2520	0	2580	120	660	120	377	46.2	5.44	84.9	16.0	2.70	999.9	274.0	8.8
2273	1	36	7900	4345	0	3160	79	237	79	307	48.1	5.86	82.0	16.6	1.00	999.9	999.9	99.9
2274	1	36	8800	5104	0	2816	440	352	88	316	48.5	5.61	86.4	16.1	2.60	999.9	114.0	6.6

APPENDIX C

THYROID SUMMARY

This 35 year old male was 8 months in utero at the time of exposure to the fallout from Bravo. In October 1989 he was noted to have a thyroid nodule in the right thyroid isthmus. He was referred to the NIH for additional evaluation. Physical examination revealed a right sided inferior thyroid nodule approximately 0.8 cm in diameter. The thyroid was of granular consistency and the remainder of the physical examination was unremarkable. Thyroid function tests were within normal limits, including a serum TSH. Ultrasound of the neck showed a large nodule. Technetium thallium scan showed a cold nodule in the lower pole of the right thyroid. Fine needle aspiration showed blood elements, no follicular cells were seen. The patient underwent a right thyroid lobectomy on 12/7/89. Pathology from the right hemithyroidectomy showed a 6x3x2.5 cm specimen containing a 1 cm hemorrhagic cyst with a 0.5 cm papillary growth within the cyst. Frozen section showed a benign hypertrophic nodule with papillary proliferation and hemorrhage. This was confirmed as a colloid cyst by permanent section. Two foci of micropapillary carcinoma, separate from the nodule, were detected. The patient was placed on suppressive Synthroid and no additional surgery was performed. Currently the patient is on Synthroid 0.2 mg. q.d. and is doing well.

APPENDIX D

This table lists all exposed persons who have had surgery which confirmed a thyroid lesion, their ages at the time of surgery, the number of years post-exposure that thyroid surgery was performed, and the thyroid-absorbed radiation dose in cGy. The code for "Nodule type" is: 1 = adenomatous nodule; 2 = adenoma; 3 = occult papillary carcinoma; 4 = overt carcinoma. In some instances there was a divided opinion as to the pathologic diagnosis; for the purposes of this table the "more malignant' diagnosis has been used (i.e., overt carcinoma > occult papillary carcinoma > adenoma > adenomatous goiter). * represents Rongelap individuals; ** represents Utirik individuals

	Age in 1954	Sex	Age at Surgery	Years post-exposure	Internal dose	External dose	Total dose	Nodule Type
*	1	M	12	11	5000	190	5190	1
*	2	F	20	18	1040	110	1150	1
*	6	F	21	15	2400	190	2590	1
*	3	F	13	10	3500	190	3690	1
*	19	F	34	15	1100	190	1290	4
*	5	M	19	14	2700	190	2890	1
*	7	M	18	11	2300	190	2490	1
*	3	F	13	10	3500	190	3690	1
*	3	M	17	14	3500	190	3690	1
*	2	F	14	12	4000	190	4190	1
*	7	M	22	15	2300	190	2490	1
*	3	F	15	12	3500	190	3690	1
*	30	F	49	19	290	110	400	1
*	23	F	43	20	290	110	400	2
*	7	F	33	26	600	110	710	1,3
*	1	M	15	14	5000	190	5190	1
*	34	F	46	12	290	110	400	1
*	8	F	20	12	2200	190	2390	1
*	28	F	39	11	1100	190	1290	4
*	1	F	13	12	5000	190	5190	1
*	28	F	53	25	1100	190	1290	1
*	14	F	45	31	1400	190	1590	4
*	4	F	45	31	1400	190	1590	4

*	7	F	22	15	2300	190	2490	4
*	16	F	38	22	1300	190	1490	4
*	12	F	30	18	2600	190	1790	1,2
*	0.7	M	20	19	680	190	870	1
*	0.3	M	25	25	0	190	190	1
**	1	F	28	27	670	11	681	1
**	5	F	30	25	390	11	401	1
**	11	M	33	22	260	11	271	2
**	17	M	47	30	150	11	161	4
**	3	F	24	21	480	11	491	4
**	14	M	44	30	220	11	231	3
**	2	F	32	30	550	11	561	4
**	12	F	32	20	240	11	251	2
**	31	F	56	25	160	11	171	1
**	35	F	57	22	260	11	171	4
**	24	F	49	25	160	11	171	1
**	38	F	64	26	160	11	171	1
**	3	F	34	31	480	11	491	3
**	37	F	56	19	160	11	171	1
**	34	F	53	19	160	11	171	1
**	33	F	58	25	160	11	171	1,3
**	52	F	71	19	160	11	171	1
**	6	F	37	31	340	11	351	1
**	18	F	33	15	160	11	171	4
**	11	M	35	24	260	11	271	2
**	3	F	30	27	480	11	491	2
**	15	F	44	29	200	11	211	3
**	4	F	36	32	430	11	441	2,3
**	0.9	M	35	34	98	11	109	3

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