Table 1. Incidence of leukemia in the Hiroshima survivors related to distance from the hypocenter and the presence of severe radiation complaints.

Distance from hypocenter	Population*			Cases of leukemia			Incidence		
	SRC†	NRC‡	Total	SRC	NRC	Total	SRC	NRC	Total
0– 999	750	450	1,200	14	1	15	1: 53	1: 450	1: 80
1,000–1,499	2,250	8,250	10,500	15	9	24	1: 150	1: 917	1: 438
1,500–1,999	1,750	16,950	18,700	3	2	5	1: 583	1: 8,475	1: 3,740
2,000–2,499	950	16,250	17,200	1	1	2	1: 950	1: 16,250	1: 8,600
2,500 and over	850	49,650	50,500	0	4	4		1: 12,412	1: 12,625
Total	6,550	91,550	98,100	33	17	50	1: 198	1: 5,385	1: 1,962

* Population estimated and rounded off to the nearest 50 persons. These population figures were based on the Commission's 1949 radiation census and the Japanese national census (1950). Numbers of survivors with severe radiation complaints were estimated from observations made by the Commission's genetics department on 19,675 Hiroshima survivors of childbearing age (*3*).

† SRC: severe radiation complaints (heavily irradiated).

‡ NRC: no radiation complaints (lightly irradiated).

center. (iii) No interaction of distance and radiation complaints is evident. That is to say, the difference in incidence between the complaint groups is not dependent on the distance from the hypocenter. (iv) A linear relationship appears to exist between the logarithm of the distance and the logarithm of the incidence of leukemia. This relationship is demonstrated by a downward slope that is significantly different from zero. (v) There is no reason to believe that a difference exists between the individual regression coefficients for the two complaint groups. Thus, the rate of decrease in incidence with an increase in distance is apparently the same for the two groups.

Further examination of the data indicates that (i) the incidence of leukemia is "high" at distances close to the hypocenter, regardless of the presence or absence of severe radiation complaints; (ii) the incidence of leukemia approaches the normal expected incidence at distances of 2500 m or more from the hypocenter.

References and Notes

* On leave of absence from Tufts Medical School and Boston City Hospital.

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1. J. J. Folley, W. Borges, and T. Yamawaki, *Am. J. Med.* **13**, 311 (1952); R. D. Lange, W. C. Moloney, and T. Yamawaki, *Blood* **9**, 574 (1954).

2. This work was sponsored by the Atomic Bomb Casualty Commission, field agency of the National Academy of Sciences–National Research Council, with funds supplied by the U.S. Atomic Energy Commission.

3. D. J. MacDonald, *Symptoms and Shielding of Genetics Parents,* Memorandum for Record (Atomic Bomb Casualty Commission, Hiroshima, Japan, 1954).

22 December 1954.

Communications

Pollen Profiles, Radiocarbon Dating, and Geologic Chronology of the Lake Michigan Basin

Wave action of the high-water stage of Lake Michigan during the past 3 yr cut deeply into flanking dunes along the eastern shore of the lake and did millions of dollars of damage to summer homes, bathing beaches, and scenic highways along the shore. Below South Haven, Mich., on the property of the summer camp operated by the Michigan Congregational Christian Conference, the waves uncovered a 30-in. layer of compacted peat perched on a 5-ft layer of sand and covered by a 25-ft dune.

The peat apparently accumulated in an interdunal pond whose bottom was sealed by an iron precipitation. The vertical cut of the peat permitted easy sampling at 1-in. intervals for pollen analysis. A trench dug to a depth of 75 in. into the sand underlying the compacted peat terminated in a basal layer of blue silt capped by a layer of wood. Samples were taken of the blue silt and of all narrow organic streaks that appeared in the 75-in. layer of sand. All samples contained sufficient pollen for a very satisfactory pollen analysis and determination of the forest history.

The 30 in. of peat record four major forest changes and an equal number of intermediate changes. The blue silt and the 75-in. layer of sand were deposited during a very prominent spruce-fir period (up to 94-percent spruce-fir pollen). The compacted peat began during the late spruce-fir period when pine showed aggressive participation in the forest cover. The succession of forests indicated in the pollen profile of the 30 in. of peat was spruce-fir-Jack pine to Jack pine-spruce-fir to Jack pine to Jack-white (red) pine (spruce and fir almost extinct) to white-red pine, to pine-oak-chestnut to oak-pine to oak-pine-hemlock-broadleaved forest.

The closing layers of the peat mark the beginning of the climatic optimum when dune activity buried the pond and compressed the peat. Radiocarbon dating (Table 1) by the University of Michigan laboratory gave the following time placement of forest changes: beginning of the pond near the close of the spruce-fir period, 8000 yr ago; the pine period, 6000 yr ago; the oak-pine period, 5000 yr ago; close of the pond at the beginning of the climatic optimum and initiation of dune building, 4000 yr ago. From the profile of a 32-ft deep bog, 15 mi inland from Lake Michigan, we know that during the past 4000 yr the climatic optimum continued to develop, as shown by increase of oak, hickory, and pine, and that in most recent times climatic deterioration occurred during which change pine has increased in abundance.

The geologic chronology of the Lake Michigan basin that can be fitted into this forest and climatic history is as follows. The blue silt underlying the 75-in. layer of sand is correlated with the Glenwood stage of Lake Chicago in the Lake Michigan basin. A radiocarbon date of 11,000 yr for the woody layer immediately overlying the blue Glenwood silts indicates that the deposition of the silts was followed by a withdrawal of the strandline, thus allowing the blue silts to be exposed to subaerial conditions, during which time the woody layer accumulated. The woody layer is correlative in time with the Bowmanville low water phase.

Following this a return to the later stages of Lake Chicago—the Calumet II stage of Bretz (*1*), and Tolleston stage—and Lake Algonquin is indicated by continuous deposition of sand containing lenses of organic material, all of which accumulated in relatively shallow water behind a barrier beach. These lacustrine sands eventually emerged from beneath the surface of the water as a result of the opening of the North Bay outlet and the fall of Lake Algonquin to the extreme low-water phase which Hough (*2*) named Lake Chippewa. During this marked decline in water level (350 ft below modern Lake Michigan) a stream connected Lake Chippewa in the Lake Michigan basin with Lake Stanley in the Huron basin by way of the present Strait of Mackinac. It was also during this rapidly falling water level that dune activity ceased in the vicinity of South Haven because of the withdrawal of the strand line that constituted the source of the dune sand. The dunes became stabilized with forest cover and the 30 in. of peat accumulated in an interdunal depression. Radiocarbon dates from the top and bottom of the peat layer reveal that the bog existed for about 4000 yr.

Uplift of the North Bay outlet caused the water level in the Michigan-Huron basins to rise to the level of Lake Nipissing. Return of the strandline to this level reinitiated dune action at South Haven; this resulted in burial of the peat and the building of a 25-ft dune above it. Since that time the shore has been eroded until the high water of 1952 revealed the buried peat layer.

The age determinations from the University of Michigan Radiocarbon Laboratory (Table 1) are the basis for an absolute chronology of the Lake Michigan basin. Sample numbers have the prefix M to distinguish them from the sample numbers of other radio-

Table 1. Radiocarbon dates.

No.	Sample	Age (yr)
M-288a	Wood from the top of the basal blue silt at the South Haven site. Dates the Bowmanville low water phase in the Lake Michigan basin.	11200 ± 600
M-288	Peat from the lowest 2 in. of the 30-in. peat layer at the South Haven site. This dates the time when the waters of Lake Algonquin had already begun to drop to the Lake Chippewa level. The date is thus a minimum for Lake Algonquin and the time that the North Bay outlet became ice-free. Judging from the pollen at this level in the peat, the waning phase of the spruce-fir period in the South Haven latitude is also coincident with this event.	$\begin{bmatrix} 8350 \pm 500 \\ 7500 \pm 500 \end{bmatrix}$ Average, 7925 ± 400
M-289	Peat from the South Haven exposure, 7 in. above the base of the 30-in. peat layer. Stratigraphically above M-288. A post-Algonquin–pre-Chippewa date. According to the pollen profile of the South Haven peat, this sample also dates the pine period.	6330 ± 400
M-290	Wood from the central part of the South Haven 30-in. peat layer. Interpreted as a date for the minimum level of Lake Chippewa in the Lake Michigan basin. According to pollen at this level of the peat, this date marks the oak-pine period at the South Haven latitude.	$\begin{bmatrix} 5000 \pm 400 \\ 5185 \pm 400 \end{bmatrix}$ Average, 5090 ± 300
M-291	The upper 2 in. of peat in the South Haven exposure. Marks the time just before dune activity was renewed as a result of the return of the water from the Chippewa low water phase to the Nipissing stage. This date thus just precedes the Nipissing maximum and, according to the pollen at this level, just precedes the Xerothermic (oak-pine-hemlock-broadleaved forest in the South Haven latitude). By inference, then, the Nipissing stage and the Xerothermic period were coincident.	$\begin{bmatrix} 4000 \pm 160 \\ 4000 \pm 350 \end{bmatrix}$ Average, 4000 ± 350

carbon laboratories. The samples are numbered in stratigraphic order, oldest (M-288a) to youngest (M-291).

Several conclusions may be safely drawn from this study: (i) The time lapse between the Algonquin and Nipissing stages in the Lake Michigan basin was 4000 yr (M-288 to M-291), with Lake Algonquin ending about 8000 yr ago (M-288) when the North Bay outlet became ice free. (ii) Lake Chippewa intervened between the Algonquin and Nipissing stages in the Lake Michigan basin about 5000 yr ago (M-290) and was coincident with the oak-pine period in southwest Michigan. (iii) The Xerothermic period reached a maximum some time after 4000 yr ago and is coincident in time with the Nipissing stage in the Lake Michigan basin.

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2. J. Hough, Final report, ONR contract N6051-07133 (1953), p. 27.

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Unusual Reagent

The authors of an article in the *Journal of Biological Chemistry* [211, 168 (1954)] acknowledge a gift of a sample of "standard human brain inhibitor." Presumably this is the basis for man's chronic difficulties in meeting the test. Who will discover the antidote?

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6 January 1955.

Bacitracin

Experiments in this laboratory on the stability of bacitracin have uncovered the interesting fact that bacitracin will form an irreversible gel with certain chemicals.

Two grams of bacitracin dissolved in 5 ml of water, alcohol, or acetone, or mixtures thereof, will form a gel in the presence of 200 mg or less of anethole, anisole, cinnamic aldehyde, and isosafrol. The time for gel formation varies with the chemical and concentration. No gel is formed in the presence of menthol, isopropyl benzene, benzocaine, ascorbic acid, oleic acid, eugenol, isoeugenol or safrol. In the presence of isopropenyl benzene (insoluble in the system) or morpholine, no gel is formed. Using morpholine as a solvent a gel is formed with the bacitracin and isopropenyl benzene. The presence of a conjugated ring system seemed necessary to gel formation except for the anomalous behavior of isoeugenol.

The gelling phenomenon occurred incidental to certain of our pharmaceutical development work and was expanded to the extent described. It is reported here as isolated behavior of bacitracin in the hope that it may be correlated with more direct investigations on the composition of the antibiotic.

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The Individual in Chemical Research

It is a fairly general belief that the individual researcher in chemistry has been supplanted in modern times by the research team. Numerical data to support this generalization apparently have not been collected.

Information on this point can be obtained by counting the number of papers in chemical journals that are written by a single author rather than by groups. There are some obvious flaws in this procedure as a measure of individual scientific endeavor, but the results are, at least, interesting. The percentage of papers written by only one author in the *Journal of the American Chemical Society* (Table 1) has indeed decreased since 1918, indicating a probable decline in individual research.

A further indication that few lone-wolf chemists exist in modern research is offered by the fact that not more than 15 authors in any one year (for the years given in Table 1) published more than two papers without coauthors.

Since the *Journal of the American Chemical Society* is sometimes accused of being primarily for organic chemists (in 1940, for example, five organic chemists were senior authors of about 10 percent of the published papers; since then the percentage from these individuals has declined), a check was also made of the *Journal of Chemical Physics* where organic chemists probably would not be represented. In both 1940 and 1950 this journal had approximately 40

Table 1. Individual papers in the *Journal of the American Chemical Society.*

Year	Total papers*	No. by single author	Percentage
1918	220	100	45
1920	302	131	43
1928	487	169	35
1930	838	244	29
1938	937	183	20
1940	1084	180	17
1948	1557	256	16
1950	2022	282	14

* Taken from reports by the editor published in the *Journal* itself or in *Chemical and Engineering News*; it does not include book reviews.