



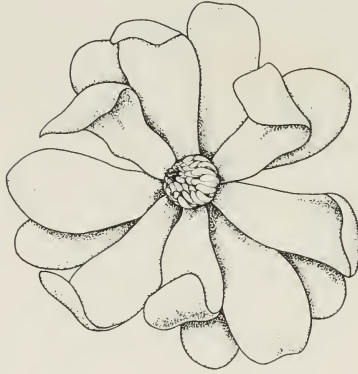
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Identification and Implications of A Hiatus in the Archeological Sequence on Marajó Island, Brazil

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ABSTRACT

Thermoluminescence and carbon-14 dates define the durations of five successive archeological complexes or phases on the island of Marajó, providing a chronology extending from about 3400 B.P. to European contact at the mouth of the Amazon. A hiatus between the end of the Mangueiras Phase about 2800 B.P. equates with a drastic decline in tree pollen in a core obtained from Lago Ararí on the eastern half of the island. Changed environmental conditions would have reduced the suitability of the region for slash-and-burn agriculture, as well as altered the wild food resources. The existence of similar lacunae of comparable age in archeological sequences in other parts of the neotropical lowlands suggests that population disruptions attributable to climatically induced subsistence stress account for the farflung and disjunct distributions of cultural traits and languages.

The growing evidence that short-term oscillations in climate correlate with the rise and fall of civilizations, geographical expansions and displacements of human groups, changes in population density, and other historical phenomena has led some historians and archeolo-

gists to suggest a causal relationship e.g.^{8,9,14,15,16,18,19,20,31,39} In South America, coincidences between climatic and demographic changes during the Holocene have been noted on the coast of Ecuador,⁷ in the Andean highlands,^{10,11,12,17} and in Colombia,³⁵ to cite representative examples.

Climatic change has also been postulated as the impetus for the population

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movements implied by the widespread and disjunct distributions of cultural elements and language families in the neotropical lowlands,^{23,24,25,28} but evidence correlating local archeological sequences with paleoenvironmental changes has been lacking. The recent discovery of a hiatus in the archeological sequence at the mouth of the Amazon that coincides with a vegetational change supports the hypothesis.

The Archeological Sequence

Prior to 1948, the archeology of Marajó Island at the mouth of the Amazon was known only from museum collections. These consisted mainly of large vessels with elaborate painted and excised decoration removed from earth mounds constructed by prehistoric inhabitants on the

eastern half of the island (Fig. 1). Survey on the north coast during 1948 revealed sites representing four previously unrecognized groups or phases, characterized by smaller settlements and simpler pottery.²⁷ Thirteen village sites were recorded, of which five were assigned to the Ananatuba Phase (PA-JO-7,8,9,10,13), one to the Mangueiras Phase (PA-JO-5), two to assimilation of Ananatuba Phase villages by the Mangueiras Phase (PA-JO-7,13), two to the Formiga Phase (PA-JO-4,6), and two to the Aruã Phase (PA-JO-2/3,11). Similar reconnaissance a few months later on the upper Rio Anajás in the center of the island revealed another site of the Mangueiras Phase (PA-JO-16), as well as two groups of large mounds of the previously reported Marajoara Phase (PA-JO-14,15).

Subsequent investigations by Hilbert²⁷ west of Lago Ararí and on the upper Rio

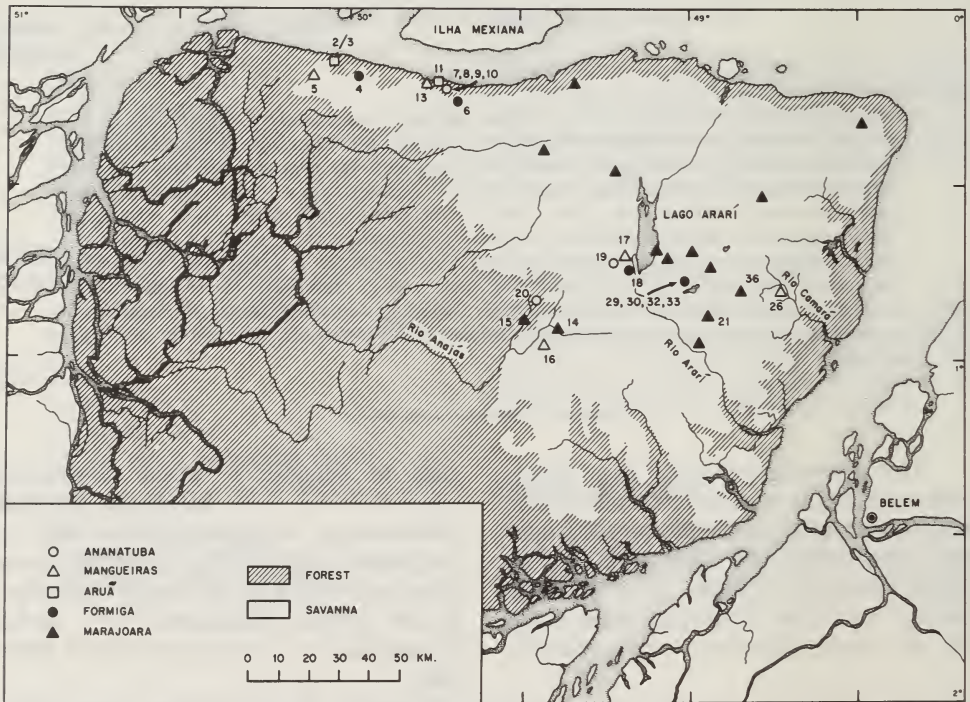


Fig. 1. Marajó Island, showing the distributions of the principal kinds of vegetation and the locations of all known sites of the Ananatuba, Mangueiras, Formiga, and Aruã phases. The Marajoara Phase is represented by a sample of sites that define its geographical distribution.^{27,29,33}

Anajás produced two more sites of the Ananatuba Phase (PA-JO-19,20), one of the Mangueiras Phase (PA-JO-17), and one of the Formiga Phase (PA-JO-18). Survey east of Lago Ararí by Simões³³ added 17 sites, including one of the Ananatuba Phase exhibiting Mangueiras Phase contact (PA-JO-26), four of the Formiga Phase (PA-JO-29,30,32,33), and 12 of the Marajoara Phase.

Pottery from surface collections and stratigraphic excavations in these sites was classified into plain and decorated types and their relative frequencies were calculated. The trends of increasing or decreasing popularity of the various types observed in the stratigraphic samples permitted establishing a relative chronology for each phase. In the absence of carbon-14 determinations, the inception of the Ananatuba Phase, the earliest in the relative sequence, was estimated after the beginning of the Christian Era.²⁷ The phases were inferred to be sequential and to have replaced one another.

Carbon-14 Dates

Carbon-14 dates obtained subsequently for two of the phases showed that the time depth for the introduction of pottery making had been drastically underestimated. A level corresponding to the Ananatuba-Mangueiras transition produced a date of 2930 B.P. \pm 200 years, implying that the Ananatuba Phase began prior to this time³⁴ (Table 1).

Three dates from Marajoara Phase sites extended from 1470 B.P. \pm 200 years to 1260 B.P. \pm 200 years. Two others were rejected, one as too early to fit the relative chronology (SI-202) and the other as too recent (SI-200). Since the Marajoara Phase sites are artificial mounds and occur in the vicinity of sites and fields of earlier phases, the SI-202 date may represent earlier charcoal introduced during construction. The recent date, 500 B.P. \pm 500 years, has so large a statistical error that it is meaningless.

Thermoluminescence Dates

Additional dates were required to evaluate these results and to expand the absolute chronology to the other three phases. The availability of pottery fragments from most of the excavations made thermoluminescence an obvious technique for obtaining them. Thirty-six potsherds were selected from 10 sites representing all of the phases. Dating was done at the Centre de Faibles Radioactivités, Gif-sur-Yvette, using the fine-grain method.¹³ Well reproducible thermoluminescence glow curves yielded good plateau responses. Internal doses were calculated from the concentrations of U, Th, and K of the samples obtained from gamma spectrometry measurements. Environmental doses were evaluated from gamma spectrometry of soil samples taken from Marajó Island. Errors were calculated as described by Aitken and Allred,⁵ and the overall accuracy of the ages was estimated at about seven to ten percent depending on the sample. It should be noted that all ceramics from Marajó are tempered with crushed sherd, minimizing possible errors stemming from differential composition.

Three Ananatuba Phase TL results are slightly older than the uncalibrated carbon-14 determination, extending from 3410 B.P. \pm 300 to 3060 B.P. \pm 270 years, but overlap when the plus/minus ranges are considered (Table 1). Mangueiras Phase occupations are superimposed on those of the Ananatuba Phase at two sites, one on the north coast (PA-JO-10) and the other near the east coast (PA-JO-26). The TL date of 3000 B.P. from the transitional level at PA-JO-10 is close to the carbon-14 date of 2930 B.P. \pm 200 years obtained for the transition at PA-JO-26. The youngest TL date for the Mangueiras Phase is 2870 B.P. \pm 190 years and corresponds to the abandonment of the most recent site in the existing seriated sequence for the phase.

The oldest date for the succeeding Formiga Phase is 1940 B.P. \pm 230 years.

Table 1.—Carbon-14 and thermoluminescence dates for phases in the archeological sequence on Marajó Island. Parenthesis indicates acceptable only within the plus or minus range.

| Date BP | Span | Lab. No. | Site | Phase |
|------------|-----------|----------|----------|-------------|
| 550 ± 500 | 50–1050 | SI-200 | PA-JO-21 | (Marajoara) |
| 600 ± | | TL | | Aruã |
| 630 ± 70 | 560–700 | TL-48 | PA-JO-21 | Marajoara |
| 800 ± | | TL-88 | | Aruã |
| 928 ± 90 | 838–1018 | TL-162 | PA-JO-36 | Marajoara |
| 1000 ± | | TL-140 | | Marajoara |
| 1113 ± | | TL | PA-JO-6 | Formiga |
| 1200 ± | | TL | PA-JO-6 | Formiga |
| 1200 ± | | TL-160 | | Marajoara |
| 1260 ± 200 | 1060–1460 | SI-199 | PA-JO-21 | Marajoara |
| 1340 ± | | TL | PA-JO-6 | Formiga |
| 1370 ± 200 | 1170–1570 | SI-387 | PA-JO-36 | Marajoara |
| 1430 ± | | TL | PA-JO-6 | Formiga |
| 1470 ± 200 | 1270–1670 | SI-386 | PA-JO-36 | Marajoara |
| 1550 ± 170 | 1380–1720 | TL-120 | PA-JO-30 | Formiga |
| 1570 ± 175 | 1395–1745 | TL-131 | PA-JO-33 | Formiga |
| 1630 ± 185 | 1445–1815 | TL-130 | PA-JO-33 | Formiga |
| 1660 ± 188 | 1472–1848 | TL-117 | PA-JO-29 | Formiga |
| 1705 ± 200 | 1505–1905 | TL-126 | PA-JO-32 | Formiga |
| 1730 ± 200 | 1530–1930 | TL-161 | PA-JO-36 | (Marajoara) |
| 1853 ± 204 | 1649–2057 | TL-132 | PA-JO-33 | Formiga |
| 1862 ± 210 | 1652–2072 | TL-127 | PA-JO-32 | Formiga |
| 1940 ± 230 | 1710–2170 | TL-125 | PA-JO-32 | Formiga |
| 2020 ± 280 | 1740–2300 | SI-202 | PA-JO-21 | (Marajoara) |
| | | (hiatus) | | |
| 2870 ± 190 | 2680–3060 | TL-76 | PA-JO-26 | Mangueiras |
| 2930 ± 200 | 2730–3130 | SI-385 | PA-JO-26 | Mangueiras |
| 3000 ± | | TL-47 | PA-JO-10 | Mangueiras |
| 3012 ± 200 | 2812–3212 | TL-81 | PA-JO-26 | Mangueiras |
| 3040 ± 270 | 2770–3310 | TL-69 | PA-JO-26 | Mangueiras |
| 3060 ± 270 | 2790–3330 | TL-79 | PA-JO-26 | Ananatuba |
| 3132 ± 205 | 2927–3337 | TL-80 | PA-JO-26 | Ananatuba |
| 3400 ± | | TL-34 | PA-JO-7 | Ananatuba |
| 3410 ± 300 | 3110–3710 | TL-78 | PA-JO-26 | Ananatuba |

Eight samples from four sites between Lago Ararí and the east coast (PA-JO-29,30,32,33) form a progression to 1550 B.P. ± 170 years. Four samples from PA-JO-6 extend from 1430 to 1113 B.P., overlapping the Marajoara Phase duration. This site is on the north coast, outside the area occupied by the Marajoara Phase, allowing the possibility of coexistence. A chronological overlap is also implied by the presence of decorated sherds of Marajoara Phase origin in the upper levels at PA-JO-6.²⁷

Three Marajoara Phase measurements, ranging from 1200 B.P. ± 200 to 928 B.P.

± 90 years are compatible with the relative chronology and the carbon-14 determinations. One appears too early at 1730 B.P. ± 200 years but is within the plus/minus range of the acceptable dates. The most recent date, 630 B.P. ± 70 years, may mark the end of the Marajoara Phase. The chronological overlap between the terminal Marajoara Phase TL measurement of 630 B.P. ± 70 years and the initial Aruã Phase TL measurement of 800 B.P. is compatible with archeological evidence for contact in the form of Marajoara Phase pottery at an early Aruã Phase site on the island of Mexiana.²⁷

Chronological Hiatus

There is a gap of some 800 years between the medians and 400 years between the plus/minus durations of the terminal TL date for the Mangueiras Phase and the initial TL date for the Formiga Phase (Table 1, Fig. 2). Although sampling deficiencies may be responsible, several considerations make this unlikely. First, all sites known to the local population in each region were examined regardless of size and composition. Second, the non-Marajoara Phase sites consist of relatively small scatters of pottery fragments, few of them decorated, making it improbable that they would be encountered or recalled more readily than sites of unre-

corded phases. Third, the number of sites representing the known phases makes it difficult to believe that a phase lasting 500 to 900 years would not have been encountered. The Formiga, Marajoara, and Aruã phases, with estimated durations of about 700 years, have the largest numbers of recorded sites. The Ananatuba Phase, with an estimated duration of about 400 years, is known from nine sites. Even the Mangueiras Phase, which has dates spanning less than 200 years, is represented at six sites.

Paleoenvironmental Reconstruction

A pollen profile obtained from Lago Ararí, in the vicinity of the archeological

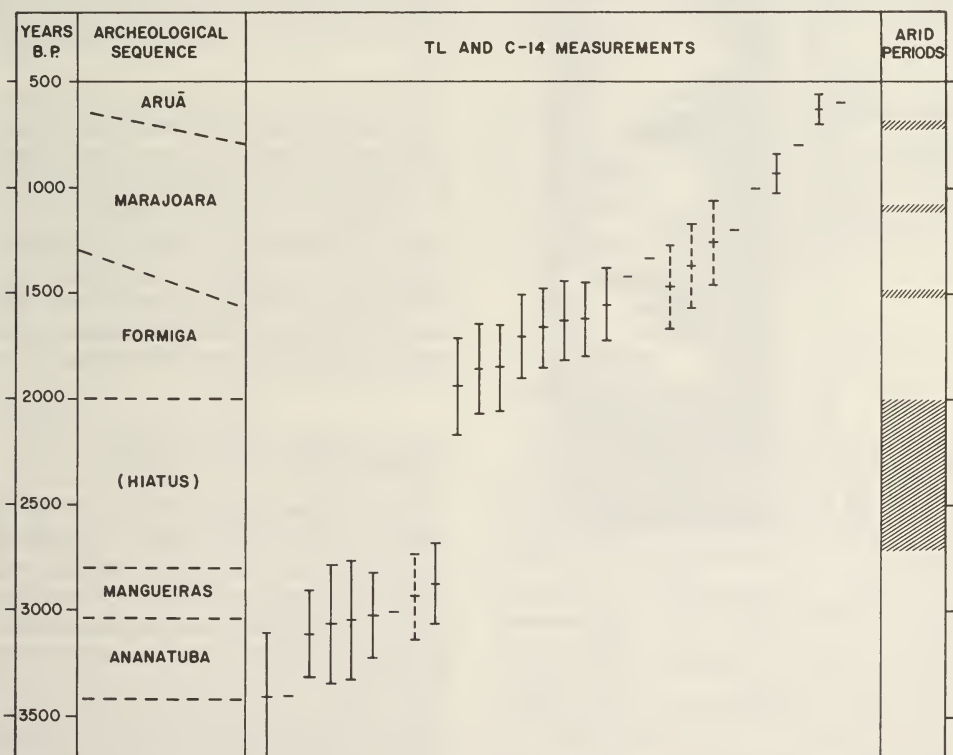


Fig. 2. Comparison of the archeological sequence on Marajó Island with episodes of aridity since the end of the Pleistocene inferred from pollen profiles. A hiatus of about 800 years between the end of the Mangueiras Phase and the beginning of the Formiga Phase correlates with a dry interval between about the same time. Broken lines indicate carbon-14 dates; solid lines, TL dates. TL dates with no plus-minus ranges represent measurements for which average (internal and external) doses were used for calculating ages. Unacceptable results on Table 1 are not included.

sites, reveals dramatic changes in the vegetation⁴ (Fig. 3). A carbon-14 date of 2590 B.P. \pm 100 years (Beta-2289) identifies the portion of the sequence of interest here. Tree pollen constituted some 70 percent of the sample earlier, but by this date the proportion had declined to about 30 percent. After an increase, it continued to decline to about 15 percent and the dominant vegetation consisted of herbs and grasses. The dates and ecological considerations make it likely that the

Ananatuba Phase arrived when forest was dominant. The terminal Mangueiras Phase date correlates with the increasing abundance of grasses, which would have diminished the possibilities for slash-and-burn agriculture and affected the kinds and abundances of many wild foods.

After an interval of uncertain duration, forest pollen increases to about 40 percent. The initial date of 1940 B.P. for the Formiga Phase is compatible with evidence from pollen studies elsewhere in the lowlands for termination of this arid interval about 2000 B.P.^{1,3,6,35} Somewhat later, tree pollen declines to about 30 percent, increases again to about 38 percent, and then declines to the present ratio of about 10 percent (Fig. 3). The latter frequency is comparable to what prevailed during the earlier long interval and conditions today may resemble those at that time.

Elsewhere in the lowlands, more transitory arid episodes inferred from palynological changes have been dated about 1500 B.P., 1200 B.P. and 700 B.P.^{1,2} The first estimate coincides with the earliest date for the Marajoara Phase and the last with the arrival of the Aruã Phase, suggesting that climatic fluctuations may have contributed to the population movements implied by these intrusions.

Evidence from Other Regions

After encountering the hiatus in the dates for the archeological sequence on Marajó, we examined other regions with sufficiently large numbers of dates that gaps were unlikely to reflect inadequate sampling. A series of more than 90 carbon-14 and TL dates from sites on the middle Orinoco in Venezuela (Fig. 4) exhibits a similar hiatus between 2605 B.P. \pm 85 years (I-9519) and 1740 B.P. \pm 100 years (QC-323); a series of 24 dates from the lower Orinoco has a hiatus between 2440 B.P. \pm 75 years (SI-865) and 1470 B.P. \pm 70 years (SI-864) interrupted by a single date.²⁶ At the opposite margin of

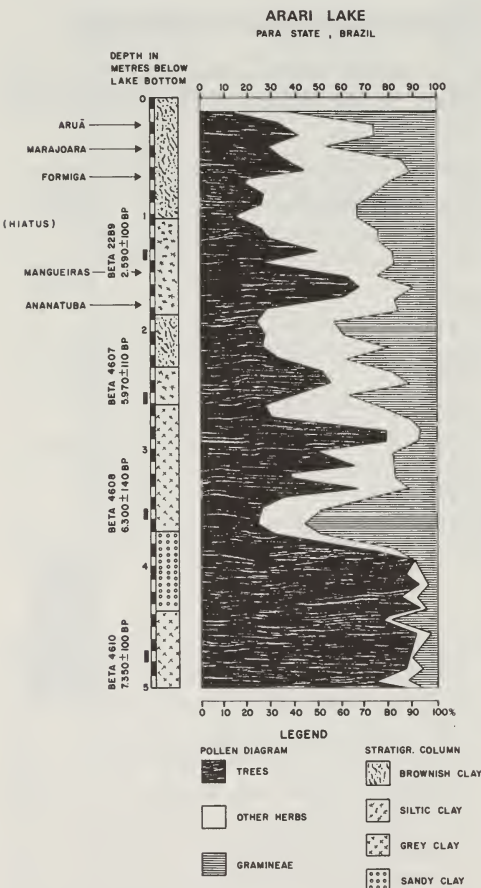


Fig. 3. Pollen diagram from a core obtained in Lago Arari showing fluctuations in arboreal vegetation and their estimated correlations with the inceptions of the archeological phases. A carbon-14 date of 2590 B.P. \pm 100 years, obtained from a level in which tree pollen was declining, falls within the hiatus in the archeological sequence.⁴

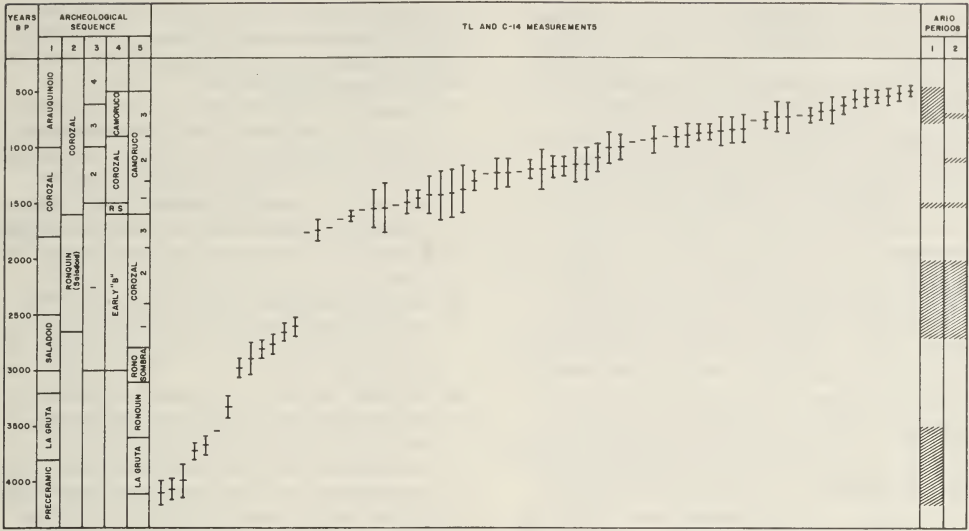


Fig. 4. Carbon-14 and thermoluminescence dates from archeological sites on the middle Orinoco, showing a hiatus similar to that observed on Marajó.²⁶ Archeological sequences: 1,²⁶ 2,³² 3,³⁷ 4,³⁸ 5.³⁰ Arid periods: 1,³⁵ 2.³

Amazonia, on the llanos de Moxos of Bolivia, a sequence of 38 dates has a gap between 2685 B.P. \pm 145 years (SI-5876) and 1705 B.P. \pm 75 years (SI-4119). Differences in the dates of inception and termination of the hiatus are to be expected, given the large geographical separations of the regions and their locations on opposite sides of the equator. All these regions are now dominated by savanna and unsuitable for agriculture.

Declines in density of settlements and discontinuities have been reported during this interval in other parts of the world. Wendland and Bryson³⁶ identified globally synchronous environmental discontinuities by comparing more than 800 carbon-14 dates and synchronicities in the appearances and terminations of 155 cultures based on some 3700 carbon-14 dates. The most significant discontinuities occurred at 2760 B.P. in the botanic sequence and 2510 B.P. in the cultural sequence.

Tabulating densities of sites according to the principal cultural periods from Early Neolithic (5000 B.C.) through the Iron Age (A.D. 1000) showed a decline

during the first millennium B.C. when the weather was cooler and moister.⁸ In northwest India, the end of the Harrapan Period coincides with the inception of an interval of exceptionally low rainfall between about 3800 and 2000 B.P.²¹

Conclusion

The coincidence between palynological evidence for the replacement of forest by grasses and herbs on Marajó Island and archeological evidence for a hiatus in cultural sequence between about 2700 and 2000 B.P. provides the first direct evidence for the impact of climatic change on the prehistoric inhabitants of lowland South America. The proportion of grass pollen today is comparable to that during the arid episode, and 88 percent of the eastern half of the island is now judged unsuitable for agriculture.²⁹ Similar climatic conditions in the past would have reduced or eliminated food resources available earlier. The prehistoric population may have responded by abandoning

the island or by fragmenting into nuclear families and subsisting as roving hunter-gatherers, as surviving Amazonian tribes such as the Kayapó still do during part of each year.²² Either option would have left a hiatus in the archeological record.

The existence of gaps of similar ages in local archeological sequences on the northern and southwestern margins of Amazonia is compatible with the evidence for climatic deterioration on a global scale during the first millennium B.C. The resulting subsistence stress could have been resolved in several ways and heterogeneous distributions of languages and cultures in Amazonia suggest that emigration was a frequent option.

As more archeological and paleoclimatological data become available, it should be possible to detect local differences in the intensity of climatic fluctuations and their effects on prehistoric human adaptation. These data are not only relevant to understanding the past; they are critical for designing successful long-range programs of present and future land use.

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The Effect of Cadmium Exposure on Metallothionein and Protein Synthesis and Cell Proliferation in Human Lymphoblasts (RPMI 7666)

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ABSTRACT

The ability of a human lymphoblast line of cells, RPMI 7666 to synthesize metallothionein (MT) has been investigated. It is apparent that the induction of MT by these cells does not protect them from the inhibition of proliferation seen on exposure to cadmium. While MT concentration in cadmium exposed cells is approximately $25 \times$, protein content is increased only about 150%. However, cell number does increase in the cadmium exposed cells but at a rate significantly less than that of the control lymphoblasts.

Introduction

Metallothionein (MT) is a low molecular weight protein that is inducible by transition state metals (Zn^{+2} , Cd^{+2} , Cu^{+2} , and Hg^{+2}).¹ After its synthesis, metallothionein binds the inducing heavy metal, suggesting that its synthesis may either be a protective mechanism against the toxicity of the heavy metal or it may control metal absorption in the gut or regulate metal ion concentrations in the tissues where they are stored.² Glucocorticoid hormones, in addition to heavy metals,

are known to induce metallothionein synthesis *in vivo* in the liver and *in vitro* in various culture systems.³

Recently it has been recognized that the increasing concentration of trace metals in the general environment, particularly in the water supplies, has become a significant problem.⁴ The immunosuppressive aspects of these trace metals have been the subject of many studies in which it has been shown that heavy metals inhibit normal immune functions.⁵ Several of these studies have evidence that cadmium suppresses antibody titres against infectious diseases,⁶ and that exposure to cadmium enhances susceptibility to bacterial,⁷ viral,⁸ and protozoal infections.⁹

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To study the effects of cadmium on MT and protein synthesis in human lymphoblasts, the cell line RPMI 7666 was used. This line was established from hematopoietic cells from two individuals with no known malignant diseases. The RPMI 7666 line is characterized by primitive cells at the lymphoblast and hemocytoblast stages. Some cells have morphological staining properties that combine those of immature lymphocytes and immature plasma cells. The line also contains particles called "leukovirus" which seem identical to those found in cell lines with leukemia or Burkitt's lymphoma. 20–50% of the cells in the RPMI 7666 line contain cells that produce immunoglobulins.¹⁰

Materials and Methods

The RPMI 7666 cell line

The RPMI 7666 cell line was obtained from American type Culture Collection, Rockville, MD. The cells, as received were immediately thawed in a water bath at 30°C and resuspended in a final solution of cold RPMI 1640 with glutamine. The cell suspension was then spun at 100 xg for 6 minutes. The resulting pellet was resuspended in the same medium at a concentration of 5×10^5 cells/ml. Ten ml were placed in 75 ml culture flasks. These cells were incubated for 3 days at 37°C in a CO₂ incubator (5.0% CO₂ and 100% humidity) when they were counted, washed and resuspended in fresh final RPMI medium at a concentration of 5×10^5 cells/ml. The cells were grown for 3 day periods until they achieved stability; that is, when cell viability (as measured with Trypan blue) remained at a relatively constant level (80%).

The stabilized cells were removed from the flasks, pelleted, and resuspended in a cryomedium, made by adding, in order, 30 mls of final RPMI 1640, 10 mls fetal calf serum, 1 mg/ml and 10 mls cold dimethylsulfoxide. The cryomedium (pH

7.1–7.4) was filter sterilized and stored at 4°C. The cells in the cryomedium were divided into 1.5 ml volumes in small cryovials, frozen in liquid nitrogen after a gradual takedown temperature at –20°C and –80°C.¹¹

Each experiment was begun by removing one vial from the liquid nitrogen freezer and immediately placing the tube in a beaker of water at 30°C. The cells were then resuspended in 3 mls cold final RPMI medium, counted in a hemocytometer and their viability determined using Trypan blue. The cells were then centrifuged at 100 xg for 6 minutes. The pellet was resuspended in 3 mls of medium at a final concentration of 10×10^6 cells/ml. The cells were then plated in 75 ml flasks at 3 different concentrations to determine the optimum growing concentration for this cell line. The flasks were placed in the incubator and the cells allowed to grow for 3 days at 37°C. After 3 days, the cells were removed from the incubator, counted in a hemocytometer and their viability measured using Trypan blue. It was determined that the optimal condition for culturing the RPMI 7666 line for exposure to cadmium, would be 5×10^6 cells suspended in 10 mls final RPMI medium for a final concentration of 5×10^5 cells/ml. These cells were grown and passed, as above, every 3 days. The cells showed a decrease in doubling time and an increase in viability with each pass.

Exposure to Cadmium

After two weeks of culturing and passing every 3 days, the cells were exposed to cadmium as follows: The cells were counted, their viability determined and the cells were pelleted (100 xg for 6 minutes) and resuspended in fresh medium at a concentration of 5×10^5 cells/ml. The cells were divided into 10 ml volumes and placed into each of six, 75 ml flasks (5×10^6 cells/flask). To three of these flasks, 0.1 ml CdCl₂ in 0.9% NaCl was added at a final concentration of 10 μM. To the remaining 3 flasks, 0.1 ml 0.9%

saline solution was added. Another 10 ml aliquot was taken from the stock cells and centrifuged. The supernatant was discarded and the pellet was placed in the freezer for subsequent analysis along with the CdCl₂ and NaCl treated cells. The NaCl and CdCl₂ treated cells were incubated for 3 days at 37°C. The flasks were swirled every 24 hours to redistribute the medium. After the three day incubation period, the cells were transferred to 15 ml centrifuge tubes, counted, and their viability determined. The cells were pelleted, the supernatant discarded and the tubes placed in the freezer for subsequent metallothionein and protein assays.

Sonication

The cell pellets were removed from the freezer, thawed and resuspended in 2 ml 10 μ M TRIS-HCl buffer, pH 7.6. The cells were transferred to 15 ml plastic tubes and sonicated for 60 pulses (output 5, pulse 50%) with a Branson sonicator. Complete cell lysis was verified microscopically. The sonicate was then transferred to microfuge tubes (2 tubes/sample). The samples were centrifuged at 10,000 xg for 5 minutes to remove all insoluble cell fragments.

Metallothionein Assay

One ml of supernatant was removed from each sample and transferred to a clean microfuge tube for the MT assay. The ¹⁰⁹Cd/hemoglobin method as described by Eaton and Toal¹¹ was used. Duplicate 100 μ l of supernatant following the Eaton and Toal procedure, were taken from each sample and placed into each of two gamma counting vials. Radioactivity present in each sample was determined in the gamma counting spectrometer (Beckman, Model 5,500) with a counting error of less than 3%. The amount of MT present in each sample was determined by extrapolating the unknowns on the MT standard curve. An MT standard was analyzed with each set of samples. The remaining

portion of the supernatant was set aside for subsequent protein analysis by the Lowry method.¹²

Lowry Protein Assay

20 μ l and 100 μ l samples were taken from each supernatant of the first centrifuged sample after sonication, for analysis of total protein content by the Lowry Method.¹² Bovine serum albumin was used as standard.

Results

Many cell types have been shown to produce MT under a variety of stimuli.¹³ It is apparent from the data summarized in Table 1 that the RPMI 7666 lymphoblast can also be induced to produce MT following exposure to 10 μ M Cd²⁺. The approximately 25 \times increase in the MT/10⁶ cells is significant ($p < 0.05$) and clearly demonstrates the induction of this protein.

Table 1 also summarizes the data obtained when the total protein content of the cells was determined. The lymphoblasts exposed to 10 μ M Cd²⁺ for 72 hours had a significant ($P < 0.05$) increase of 150% that of control cells. When fibroblasts are exposed to this concentration of cadmium, protein synthesis as measured by radiolabelled amino acid uptake was decreased. While the use of amino acid uptake can measure the rate at which translation may be occurring, it does not

Table 1.—Change in protein concentration, cell growth and metallothionein content of lymphoblasts in response to cadmium exposure.

| | Cadmium (2+) | Concentration |
|--|------------------------|------------------------|
| Metallothionein μ g/10 ⁶ cells | 0.11 \pm 0.21 (7) | 2.86 \pm 1.55 (7) |
| Protein μ g/10 ⁶ cells | 218 \pm 76 (7) | 315 \pm 82 (7) |
| Cell Number $\times 10^6$ | 29 \pm 20 (6) | 17 \pm 13 (6) |

() = Number of samples

necessarily measure the total amount of protein present.

In previous experiments, we have reported that 10 μM CdCl_2 results in a decrease in DNA synthesis.¹⁴ This condition is reflected in the data also contained in Table 1. It is clear that there has been an increase in the number of lymphoblasts from 5×10^6 to 29×10^6 in the control cultures but only to 17×10^6 in the cadmium exposed cells. Thus, while cell proliferation has continued, it does so at a significantly lower rate in the cadmium exposed cells. It would appear that cell growth has continued but without cell division taking place at the same rate as in the control cells.

Discussion

Several reports have suggested that MT acts to prevent the cytotoxicity of heavy metals.¹⁵ It is surprising, therefore, that in these studies, the induction of MT has little protective effect on cell proliferation. It has been our thesis that MT, as a response to cell stress, may, in fact, modify the availability of biochemical factors that modify enzyme activity. In recent reports, we have shown that the activity of lysyl oxidase, a Cu^{2+} requiring enzyme, inhibited following cadmium exposure, can be returned to full activity by the addition of 1 μM CuCl_2 to the assay medium. We have also reported that prolyl hydroxylase had increased activity, probably due to increased enzyme, following cadmium exposure. In the same experiments, the amount of lysyl oxidase appeared to have been increased. These events were associated with MT induction. It would thus seem that the presence of MT may result in a variety of changes depending on the system being examined. Furthermore, the protective effect of MT against heavy metal toxicity can be modified by metabolic changes, a result of the biochemical activity of the MT molecule.

The cytotoxicity of 10 μM CdCl_2 is readily seen in the decreased growth rate

of the lymphoblasts exposed to this concentration of cadmium. While the cells continue to divide, the increase is significantly less than that of the control cells. It is interesting to note that in the face of decreased cell proliferation, the protein concentration per 10^6 cells has increased. In other studies 10 μM CdCl_2 can cause a decrease in the incorporation of labeled amino acids into protein, an indication of a decrease in the rate of translation. We have reported that cadmium will affect RNA as well as DNA synthesis in lymphocytes.¹⁶ It would not be unreasonable to expect that with decreased cell division that there could be an accumulation of protein in each cell as it grows. Other investigators have reported that MT protects animals¹⁵ or cells¹⁵ from the cytotoxicity of heavy metals, in this case, cadmium. In the lymphoblasts studied here, MT increases about 10 fold in the cadmium exposed cells. Yet this increase fails to protect fully, the cells from the cytotoxicity of the cadmium. It is, of course, reasonable to expect that the degree of protection is a function of the concentration of MT in the cells. We have shown in fibroblasts and lymphocytes the concentration of MT is a function of both the concentration of cadmium and the time of exposure. In the present case, the affect of the cadmium on the transcription and translation may have occurred before protection by MT can be fully expressed.

In summary, actively metabolizing lymphoblasts will respond to heavy metal, Cd^{2+} , exposure to produce MT accompanied by an increase concentration of protein in the cell and a decrease in cell proliferation.

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Male-Female Admission Differentials in State Mental Hospitals, 1880-1980

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ABSTRACT

Many researchers postulate that women are more vulnerable to mental illness than men, especially in highly industrialized societies. Point or period prevalence by sex can only be ascertained by carefully designed community and institutional field projects. The present study examines one aspect of this issue through analysis of admissions, by sex, to State mental hospitals for the period 1880-1980. While the admissions sex ratios vary somewhat over the decades, ratios show that males consistently outnumber females in admissions for all periods examined. Furthermore, this differential has increased since 1950. Possible explanations for these trends are explored.

The legacy of epidemiological research in mental health includes various attempts to relate sociodemographic risk factors, including sex, race, age, etc., to psychiatric disorder. Historically, Jarvis (1850) was one of the first professionals to become interested in the question of the "comparative liability of males and females to insanity." He first analyzed scholarly opinion on the matter and found no consistency emerging. He then obtained admission and residency reports from 250 hospitals for the insane located in Northern Europe and America. Jarvis found that, overall, men were more liable

to hospitalization than women, and as a result more vulnerable to mental disorders.

In recent popular writing and in the professional mental health literature, it has been commonly stated that women are more vulnerable to mental health difficulties than are men, although a few researchers are suggesting a decline in adult sex differences in mental health problems (McLanahan and Glass, 1985; Kessler and McCrae, 1981). Women are reported to be more susceptible to neuroses, depressive disorders, and psychophysiological disorders than men (Weissman and Kler-

man, 1977; Kleinke et al., 1982). Distress ranging from mild emotional problems to phobias and fear of possible breakdown is more often reported for females than for males (Al-Issa, 1980; Belle, 1982). Inferences are usually based on utilization data from public mental hospitals, private mental hospitals, outpatient clinics, or on community self-report survey data. Two reports often cited are those by Chesler (1972) and Gove and Tudor (1973). In the book *Women and Madness*, Chesler states that there is a consistently larger "female involvement with psychiatry" in America than is the case for men. Stressing inpatient residency patterns, she states that "between 1950 and 1968, 223,268 more women than men (many of them old women) were confined in State and county hospitals" (1972: 120). This statement has been widely quoted.

Gove and Tudor (1973) hold that since 1950 the evidence clearly points to a higher female vulnerability in both treatment and community study results, although they admittedly use a limited definition of mental illness. Kessler and McRae (1982; 1983) report a post war shift toward a higher proportion of females to males in the sex ratio of psychopathology, as evidenced by both findings from a national survey on self-reported, psycho-physiological stress and from results of normal population studies of trends in attempted suicide. The Dohrenwends (1976) suggest that caution is in order, in that methodological differences between the pre-1950 and post-1950 studies make interpretation difficult.

From Parsons and Bales (1955) to Gilligan (1982), it is suggested that the roles of women and men have differed in important ways. Women are trained to focus on the socio-emotional realm and on interpersonal relationships, while men are socialized to focus on instrumental, task and provider functions. This implies that the sick role is more culturally acceptable for women than for men. One can argue from this stance, and writers such as Padesky and Hammer (1981), and Coop-

erstock (1971) do, that women not only more easily express feelings and emotions, and admit to emotional difficulties, but also seek out help more when feeling distressed. Phillips and Segal (1969) found that, when men and women have the same level of physical symptoms, women report more distress than men. Kessler et al. (1981) report evidence that when women and men indicate comparable feelings of distress, the women are more inclined to seek out psychiatric treatment than men.

Gove and Tudor (1973) examined reports of research on sex roles in relation to mental illness. They found that reports differed in results depending on the time period in which the research took place. Those studies done previous to 1950 reported higher rates of mental illness for males. These studies tended to use treatment data. On the other hand, Gove et al. (1973) also found that in the post 1950 period reported rates of mental illness for females were higher than for males in both community studies and treatment statistics.

As Kessler and McRae (1983) point out, empirical research focusing on trends in the relationship between gender and mental health is scant. More definitive work focusing on trends is suggested. Community surveys based on self-report data are available for the post World War II period, as is true of utilization records from outpatient clinics. However, mental hospital archival data provide the only consistent source for the study of long-term trends in utilization of mental health services, and they will be used here. Comparable data by sex from treatment records are available for the State mental hospital system, but not consistently for the private sector. In essence, the project becomes a utilization study of State mental hospital inpatient services over time, by sex of clientele. This means that the data set will be biased toward the inclusion of the lower socioeconomic classes. Rothman (1971) suggests that, from the civil war period onward, the middle and upper classes frowned on use of the State

mental hospital system for their own members. Nevertheless, the State mental hospital system included the majority of the long-term hospitalized mentally ill cases in the United States until 1960. If one excludes the Veteran's Administration system, in that year the State system included 84 percent and private hospitals 16 percent of the regular long-term admissions (NIMH, 1960). In spite of the development and expansion of alternate community services in the sixties and seventies, the State mental hospital system accounted for about 60 percent of all inpatient days of care in 1975.

Framework

The State hospital setting provides a sound base for the study of mental illness trends over historical time periods. Concerns with respect to differential help-seeking motives, continuity of data, and comparability of data can be dealt with more directly than in other settings. Established between 1840 and 1890 to replace inadequate local facilities, State mental hospitals always reflected a conflict between social control and rehabilitation goals (Grob, 1983). Despite the strenuous efforts by local leaders, many hospitals eventually lapsed into control-custodial institutions in the public eye, if not in reality (Rothman, 1971). Under such circumstances, self-help motives were often overridden by fear of hospitalization for most potential clients or their sponsors. The negative stigma attached to the State mental hospital was furthered by the local commitment process. Traditionally, individuals who exhibited severely disordered behavior according to local norms were, when toleration limits were exceeded, informally and then legally processed toward the State institution unless an alternative could be provided (Perucci, 1980). Gove and Tudor (1973) suggest that hospitalization in a State mental hospital

setting is usually initiated by someone other than the defined patient. It should follow that self-help motivation would be low, and an excess of female admissions based on differential help-seeking motives should not induce the data bias it might in other contexts.

The historical predominance of the State mental hospital system in the treatment of mental illness provides the most consistent base of completed case records available from any source. Reports on admissions by sex are available for most five year intervals since the 1880's. The records involve "official cases" which were processed by the local governmental system. Cases resulted from actions originally initiated by relatives or community peers based on local or lay definitions of mental illness rather than by psychiatric processing and case definition (Hollingshead and Redlich, 1958). This data set does not suffer from the differences in methodology that Dohrenwend and Dohrenwend (1976) enumerate in reference to field studies methods.

Data for this study were obtained from reports by the U.S. Bureau of the Census, the Public Health Service, and the National Institute of Mental Health for the 1880-1980 period. Governmental efforts to enumerate the mentally ill started with the census of 1840 and have continued to the present. The history of the National Reporting Program for Mental Health Statistics is detailed elsewhere in two reports (Redick, Manderscheid, Witkin, and Rosenstein, 1983; Stroup and Manderscheid, 1988). Specific data sources are cited in the footnotes to Table 1. State mental hospital data were separated from those based on other treatment sources as carefully as possible.

Admission data for State mental hospitals used in the study are indicated in Table 1, with column one specifying the year, and columns two and three the number of admissions by sex. The ratio of male admissions per 100 female admissions is listed in column four. Since the ratio of males to females in the U.S. total

Table 1.—Number of admissions^a by sex, male-female admissions ratio and admissions ratios per 100,000 population, State mental hospitals^b United States, 1881 to 1980.

| Year | Male | Female | Male-Female Ratio (100) ^c | Male per 100,000 | Female per 100,000 | Corrected M-F ratio |
|------|---------|---------|--------------------------------------|------------------|--------------------|---------------------|
| 1881 | 8,874 | 7,743 | 115 | 34.6 | 31.3 | 111 |
| 1885 | 12,153 | 9,455 | 129 | 42.2 | 34.3 | 123 |
| 1890 | 14,389 | 11,255 | 128 | 44.9 | 36.8 | 122 |
| 1895 | 17,268 | 13,514 | 128 | 48.7 | 39.9 | 122 |
| 1900 | 21,408 | 19,435 | 110 | 55.1 | 52.2 | 106 |
| 1904 | 23,131 | 18,260 | 127 | 54.9 | 45.6 | 120 |
| 1910 | 30,008 | 23,444 | 128 | 63.1 | 52.3 | 121 |
| 1915 | 37,965 | 28,967 | 131 | 73.6 | 59.1 | 125 |
| 1922 | 42,570 | 30,493 | 140 | 76.2 | 56.3 | 135 |
| 1930 | 40,743 | 32,709 | 140 | 73.4 | 53.8 | 136 |
| 1935 | 51,422 | 38,542 | 133 | 80.2 | 61.0 | 131 |
| 1940 | 62,307 | 47,812 | 130 | 93.9 | 72.7 | 129 |
| 1945 | 59,694 | 55,693 | 107 | 85.2 | 79.7 | 107 |
| 1950 | 79,992 | 66,646 | 120 | 105.9 | 87.5 | 121 |
| 1955 | 95,282 | 78,841 | 121 | 116.2 | 94.7 | 123 |
| 1960 | 120,961 | 99,655 | 121 | 135.4 | 109.1 | 124 |
| 1965 | 145,707 | 115,609 | 126 | 152.4 | 117.1 | 130 |
| 1970 | 274,761 | 184,762 | 149 | 274.0 | 176.6 | 155 |
| 1975 | 248,937 | 136,300 | 183 | 239.9 | 124.6 | 193 |
| 1980 | 239,400 | 129,649 | 185 | 217.6 | 111.3 | 196 |

^aAdmissions include admissions and readmissions; 1970 through 1980 data based on additions, which include admissions, readmissions, and returns from long-term leave.

^bIn states such as Wisconsin where county hospitals are functionally equivalent to state sponsored ones, county data have been included.

^cThe population used in the calculation of the rates is based on Series A 23-28 Historical Statistics of the United States, Colonial Times to 1970, Part I. U.S. Bureau of the Census, Washington, DC, 1975; and Annual Statistical Abstracts of the U.S. for 1975 and 1980.

Sources of this data:

1. 1881-1885: Census Report, Insane, Feeble-minded, Deaf and Dumb, and Blind in the United States, 1890. Washington, DC, U.S. Govt. Print. Off., 1895.
2. 1890-1904: Census Report, Insane and Feeble-minded in Hospitals and Institutions, 1904. Washington, DC, U.S. Govt. Print. Off., 1906.
3. 1910: Census Report, Insane and Feeble-minded in Institutions, 1910. Washington, DC, U.S. Govt. Print. Off., 1914.
4. 1915: Census Report, Statistical Directory of State Institutions for the Defective, Dependent and Delinquent Classes, 1916. Washington, DC, U.S., Govt. Print. Off., 1919.
5. 1922: Census Report, Patients in Hospitals for Mental Disease, 1923. Washington, DC, U.S. Govt. Print. Off., 1926.
6. 1929-1965: NIMH, Patient in Mental Institutions.
7. 1970: NIMH, Statistical Note 106.
8. 1975: NIMH, Series CN No. 2. Characteristics of Admissions to Selected Mental Health Facilities: 1975. DHH5 Publication No. (ADM) 81-1005. Washington, DC, U.S. Govt. Print. Off., 1981.
9. 1980: Unpublished data, Division of Biometry and Epidemiology, NIMH.

population has varied over the decades, we have related admissions to their population base by sex for each year reported. The rate of male admissions per 100,000 males is given in column five and the rate of female admissions per 100,000 females is shown in column six. The male rate per 100,000 is then compared with

the female rate per 100,000 in the form of a male-female ratio with a base of 100, by calculating column five/column six × 100. The resulting male-female admission ratio, shown in column seven is adjusted for the number of each sex in the total population for the respective year under consideration.

It is not possible to trace patient status by diagnostic sub-category for this study, since relevant data do not exist for the earlier periods. However, it should be noted that for the 1923–1980 period, diagnoses of major psychoses and neuroses have been predominant. Sub-categories characterized by “acting-out” behaviors, including personality disorders and alcohol related syndromes, have been more typically male related, with sub-categories suggesting depression or anxiety more typically female-related. While the relative distribution of clinical subcategories has varied somewhat, there has been reasonable continuity over the century. Aggregate admission data without diagnostic subclassification will be used in this paper.

Findings

As background to the analysis of the 1881–1980 data, it may be of interest to review Jarvis’ 1850 findings and to examine briefly the method and results of the special 1880 census survey. As part of a total survey of admission to 250 European and American mental hospitals, Jarvis obtained records by sex for twenty-one mental hospitals for the period 1820 to 1849. He found that the cumulative male admissions were 13,473; female, 11,100. The American results were congruent with those from northern Europe. When Jarvis’ data are reanalyzed by focusing on the public mental hospitals only, the results indicate 8,671 male and 6,969 female admissions. This represents a utilization level of 124 males per 100 female admissions for the 15 public mental hospitals of that era.

The special census of 1880 is of interest. For that census, a special agent of national reputation, Fredrick Vines, was charged with collecting data on the “Defective, Dependent, and Delinquent” classes of the population. To collect this special data, regular field enumerators

asked family heads to indicate insane members of their households. These returns were supplemented by reports from nearly 100,000 physicians from all sections of the country. The survey included both community and institutional data. The results showed 91,959 mentally ill persons in total, of whom 47,568 were females and 44,391 were males. As Vines noted, of the total females 20,307, or 43 percent, were hospitalized, while among the males, a total of 20,635 or 46 percent were hospitalized. These data show a tendency to admit proportionately more males to State mental hospital inpatient services.

From the 1880 census survey, one can infer that there were 23,756 males and 27,261 females delineated by census count who were defined as mentally ill but who had not been hospitalized. From this pool and any new incidence cases would theoretically emerge the new admissions for 1881. As can be seen in columns two and three of the table, 8,874 males and 7,743 females were admitted to State mental hospitals in 1881. The 8,874 males represent 37 percent of the pool of 23,756 non-hospitalized mentally ill males reported in the 1880 census. The 7,743 females represent 28 percent of the pool of 27,261 non-hospitalized mentally ill females who were enumerated in the 1880 special census. Turning to column four of Table 1, one notes that the ratio of male to female admissions was 115 to 100 in 1881, a ratio slightly below the 124 Jarvis found for the pre-1850 period. Except for dropping back around 1900, this level remained remarkably stable through World War I. The level becomes slightly higher, about 140, during the early twenties, and then a steady decline begins, which continues through to the end of World War II.

As discussed previously, the admissions ratios shown in column seven have been “corrected” by relating the admission numbers by sex to their respective population bases in the United States. Males outnumbered females from 1880 through 1945. Since 1946, females in the United

States have consistently outnumbered males. Correcting for the size of the population base by sex does not materially affect the results as described above. From the post Civil War era to the World War II period, male State hospital admissions were consistently higher than those of females, even correcting for the number of each sex in the population at large.

Two features stand out in the 1950–1980 period. First, in no instance do female admissions exceed those for males. Second, the tendency toward a discrepancy is more pronounced at the end of the period than at the beginning. The year 1950 does seem to be natural break point, however, as has been suggested before by Gove and Tudor (1973). Contrary to expectations based on the work of these authors, nonetheless, the proportion of female admissions to State mental hospitals go steadily down after W.W. II. As we view the total century of admission patterns, it is clear that a general principle is at work. In the United States, there has been a consistent tendency, as measured by fifth year data points for male State mental hospital annual admissions to outnumber female annual admissions. This generalization holds even when the admission totals are adjusted to take into account population base by sex.

Discussion

The Setting

The function of the State hospital system as a setting for treatment deserves further consideration. Grob (1973), Rothman (1971) and Horwitz (1977), among others, provide thorough historical analyses. All are in agreement that most early hospital superintendents believed in a positive, moral treatment approach, housed in a stable, ordered environment. For various reasons, early expectations based on the concept of curability were not to be realized. Disillu-

sionment became a common feature of administrative and staff attitudes. Financial pressures were common when State legislative committees came to realize the magnitude of expenditure output needed to maintain the hospitals. By the 1880 period, the state hospital as an institution had become entrenched. However, a custodial-control function rather than the original rehabilitative theme predominated. Paupers and the immigrant insane, especially those considered troublesome and dangerous, were vulnerable to "incarceration." This meant that the institution developed an image as a "dumping ground for social undesireables," and it lost the support of the middle and upper classes as far as utilization for their own family members was concerned (Rothman, 1971).

Local Referral

Potential patients emerge in communities. How the lay process operates to define individuals as mentally ill is not well understood and needs further study. The evidence is strong that community stereotypical concepts of mental illness exist in most if not all cultures. In studying psychiatric labeling cross-culturally, Murphy (1971:1028) suggests that "... almost everywhere a pattern composed of hallucinations, delusions, disorientations, and behavioral aberrations appears to identify the idea of losing one's mind. . . ." Individuals exhibiting such symptoms are viewed as potential sources of trouble, and techniques for managing them emerge. Lynch (1983) has recently documented a series of accommodative practices which family members and close associates use as control mechanisms for interacting with disturbed individuals. As he points out, individuals "are committed to mental hospitals after informal efforts to accommodate them in society fail." Mechanisms used in accommodation include minimizing contact with the troublemaker, man-

aging his/her actions, and attempting to influence reactions of outsiders.

From certain perspectives, accommodation practices mean that recognition of need for assistance or treatment is delayed (Yarrow, 1955). Hollingshead and Redlich (1958) found that, for families of lower socioeconomic status, vigorous efforts were made to delay recognition of any need for counseling or hospitalization in a mental facility. This delay in seeking treatment not only complicated the eventual therapeutic process, but often meant that intervention by the police was typically necessary to justify hospitalization. For such families, defining the problem as a behavioral-legal one rather than as a medicopsychiatric issue was evidenced in the original Yale study in 1958. That policy action is still involved in hospitalization in recent times is often reported (Glasscote, et al. 1975; Schwitzgebel, et al. 1980).

Official procedures are instituted only as a "last resort" when accommodation practices are no longer functional. The process whereby a change in accommodation takes place and actions lead to institutionalization needs further delineation and study. Obviously, for those hospitalized, some factors lead to the emergence of a "tipping point". Smith, et al. (1963) suggest that, for their sample of schizophrenic patients, actions defined locally as "dangerous" built up to levels that made moves toward hospitalization seem virtually necessary.

A central issue here is that of family dynamics. Acting out behaviors are very disruptive, but behaviors indicating moodiness or severe depression are also disruptive in familial and local situations. Either disorganized or depressive behaviors mean that normal routines are broken. The individual cannot carry on or function in the regular role to which all are accustomed. If disruption reaches a certain perceived critical point, action is finally taken (Goffman, 1971).

Until 1950, compulsion was a significant factor in the commitment process in

the majority of cases. After formal complaint, a hearing was held during which the judge had to decide whether or not the individual was legally insane. Typically, medical advice from one local physician was required. In most cases, technical criteria which emerged in the Diagnostic and Statistical Manual II or III could not have been used. This means that lay, non-professional mental health case definitional concepts were used as criteria for judgment. For those cases where it appeared to the local authorities that a serious condition was involved, hospitalization in a State facility had few if any practical alternatives.

The late 1960's and the 1970's were to bring positive changes in mental health philosophy and approach. Deinstitutionalization theory stressed the breakup of the State hospital system, the transfer of residents to the community, and the prevention of admission or readmission to institutions (Bachrach, 1976). Decentralization of services and crisis intervention, as against long term care, have been emphasized. Legal challenges to traditional commitment have stressed and obtained more emphasis on voluntary commitment, due process standards in pre-commitment hearings, and the possibility for the patient of a treatment-oriented facility providing the "least restrictive environment." While progress toward these goals has been uneven, significant changes have been made in deinstitutionalizing previous populations and adding community based services (Lamb, 1975). The goal of "normalization"—of making life for a patient or expatient as regular as possible—can hardly be challenged as an ideal explanation.

The question still remains: Why do more men than women appear on the admission rolls if the total prospective pool size is slightly tipped toward more females? Societal reaction processes must be given consideration. It is suggested by a number of studies that men receive more negative reactions than women for exhibiting the same level of disturbance. Using hypo-

thetical case descriptions, Phillips (1964) found respondents consistently rejected males more strongly than females. Fletcher (1969) and Larson (1970) report similar findings. Further Raskin et al. (1966) and Cannon and Redick (1973) all report that mentally ill males are hospitalized at an earlier age than females. The studies suggest that the difference is not due to a timing of symptoms but rather to the severity and rapidity of societal reaction to the perceived psychotic behavior. As Gove and Tudor (1973) and Windle et al. (1982) point out, societal reaction pressures would be exhibited most strongly where hospitalization is initiated by someone other than the defined patient. Commitment to the State mental hospital would seem to meet that test better than most other instances of utilization.

We suggest that the clientele of the State hospital typically appeared for admission as a result of a local sorting process dominated by lay concepts and influence (Dohrenwend, 1983). It would appear that, as the mental health historians have suggested, the control-custodial function of the State hospital has historically been stronger than that of rehabilitation. It would follow further that—if disturbed males have been perceived by the public to be more difficult to accommodate locally than disturbed females—more of the former would be processed into the State mental hospital.

Recent Trends

The above analysis would seem to hold well for the general historical tendency of male domination in admissions, but how is the recent continuation of the trend to be explained? To do so, reference must be made to both societal conditions and to new potential patient populations. First, developments in the commitment arena deserve special attention. The focus of the legal hearing is moving away from the subjective definition of mental status or

psychopathology toward the specification of behavioral acts or events (Stone, 1977; Shah, 1975). The pivotal point emerging is that of dangerousness to self or others for involuntary patients. Courts are reported to be insisting on clear and convincing proof regarding dangerousness on the part of the client, and physicians who testify are asked to indicate the probability level of overt, dangerous acts taking place in the future (Dix, 1980). The recent stress on dangerousness and overt behavior has pressured the physician to move to a defensive medicine posture (Lebensohn, 1978). Certification for involuntary commitment is less open to subsequent legal challenge if overt, disruptive acts can be specifically documented (Stone, 1977; Stromberg, 1983). This change in legal focus is apparently reflected in the trends of involuntary commitments to State mental hospitals. In 1972, involuntary admission were involved in 42 percent of the cases (Meyer, 1974), and it was projected that they would go to still lower levels (Gove, 1980). But, by 1980, involuntary admissions to the total State hospital system involved 51 percent of the cases (NIMH, 1984).

Meanwhile, in regard to client characteristics, reports are emerging from various parts of the country suggesting the development in the local community of a new chronic, long-term patient population. The statement by Schwartz and Goldfinger (1981:480) will be quoted at length, since it is rather typical.

“A subgroup of chronic mentally ill persons who have had little or no state hospitalization and who are difficult to engage in existing systems of community care is emerging in major urban areas. Observations made at a large municipal general hospital indicate the patients are typically young, more likely to be male, and highly transient. They have frequent interactions with emergency psychiatric and crisis units. . . . They are typically unwilling to voluntarily accept continuing care.”

Many individuals of this type are borderline both socially and clinically. They tend to engage in impulsive, self-destructive, and, on occasion, aggressive behavior which brings them to public attention. Not being typical "criminals," they are often rejected by the criminal justice system and required to relate to the mental health system. Again, they appear and reappear in various parts of the mental health service system where they "present persistent and frustrating problems" (Pepper et al., 1981). Eventually, many such individuals appear at State hospital admission centers (Belcher and Toomey, 1988). Whether legally they are defined as involuntary patients or not, they frequently tend to be reluctant ones.

The emphasis in this paper is on admissions rather than inpatient residency data, but attention to the latter may be important here. A recent NIMH study of "chronic" State mental hospital inpatients admitted between 1975 and 1978 found that males accounted for seventy-five percent of the patients 24 years of age or younger (Taube, et al., 1983). De Risi and Vega (1983) describe the demographic characteristics emerging from two recent surveys of California State mental hospital resident patients. They report a "population that is primarily of low socioeconomic status, almost half of whom have engaged in dangerous behavior and one-third of whom are still considered dangerous." And further, "men in a low-income bracket are more likely to be patients in State hospitals and to be treated for severe psychoses, personality disorders and alcohol problems." Two-thirds of the patients were male. In his follow-up to the original Yale study, Mollica (1983) reports that while, in the 1950's, males and females inpatient residents of State hospitals were roughly equal, in 1978 two-thirds of the patients were male, most of whom were of lower social status. Reflecting on recent inpatient trends, Taube et al. (1983) were led to conclude that "by deinstitutionalizing large numbers of patients over the last two decades, we may

have once again made apparent our societal need to have a place to put individuals who are deviant but who are not criminals."

It appears then that community pressures to institutionalize disruptive individuals, who are often perceived to be dangerous, are still very much in existence. The stress on dangerousness in relation to mental illness has many negative features. Bachrach (1979) suggests the possibility that in the issue of dangerousness "lies a substantial portion of the explanation for the emotionalism and polarization surrounding the entire question of deinstitutionalization." If so, this, coupled with court and media stress on dangerous behavior of the mentally ill could encourage negative latent attitudes toward this population. The present writers agree with Barton and Sanborn (1978:317) who hold that "only a few with serious mental disorders are truly dangerous." Many members of the general public think otherwise. Clearly, public education regarding adjustment patterns of the mentally ill as a total class, and their potential for regular community living represents a continuing challenge to the mental health field.

Implications

For the modern mental health field, a number of issues have emerged which focus on the State mental hospital system. Many spokespersons have argued for outright, rapid abolition of the State hospital concept as such (Okin, 1983). Others have proposed a model treatment facility which would involve a transformed hospital that stressed a non-restrictive patient environment, short term inpatient care, outpatient services and community follow-up care (Miller, 1981; Stewart, 1975). Few writers have held that a status quo or business-as-usual approach is legitimate. The modern mental health movement has included a number of community oriented

themes that have received general acceptance among both theorists and practitioners. Included would be community based care, availability of alternative types of care, individualized and continuous care, psychosocial as well as medic-biological type service, involvement of the family in the therapeutic process and mainstreaming of the individual client to the highest degree possible (Lamb, 1983; Mechanic, 1975).

Without question this new community orientation has led to a broadening of local psychiatric services. Not only is the base of service broader, the range and types of offerings are greater (Thompson, Bass, Witkin, 1982). This means that, compared to previous periods, persons across various age, socioeconomic, and disability levels have greater availability of choice. Enlarging and sustaining this growth will be a challenge for the future.

Conclusions

Social resource and labeling theory would suggest that females, being of lower status and power, would be more vulnerable to mental illness in terms of overall prevalence. We have used this assumption as a working hypothesis and turned to a concern with differentials in sex-based utilization of service, with a focus on State mental hospital admissions. The issue of "true prevalence" by sex is still important in terms of theory and practical need assessment. More sophisticated approaches combining epidemiological research and service utilization in the same studies are needed, and some NIMH research projects such as the Epidemiological Catchment area program are moving in that direction (Regier, 1980; Regier, *et al*, 1984).

Results from such projects would allow intensive study of the interface between the informal and formal delivery system. The informal support system has functioned traditionally without a high degree

of scientific, epidemiological knowledge of the distribution of particular disorders. Whether scientific feedback from field study results will have a practical impact on the informal support system remains a problem to be researched. In the meantime informal processing will continue. Informal societal processes and community needs or perceived needs should be taken into account by those concerned with planning and delivery of mental health services. Trends which are shown in this paper suggest the continued existence of societal pressure to move individuals, primarily males, perceived as disruptive and seriously mentally ill, toward a structured, controlled environmental setting. Community education, further development of community-based services, and pertinent research are indicated.

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