6. Special Cases: Long Island groundwater and Monmouth County resorts.

a. Long Island groundwater. -- As previously noted the availability of groundwater supplies has enabled Long Island industries to rely on private supplies. Consequently per capita distribution in Nassau and western Suffolk counties is 100 gpcd, thirty-five percent below the Regional average.

Nevertheless, intra-agency distribution within the forty-one agencies serving more than 1,000 persons ranged from less than 70 gpcd to more than 200 gpcd. Three factors explained all but a small percentage of the variance in per capita distribution: the presence of sewer systems, median family income, and the nonresidential floor space variable. A preliminary examination dichotomized the agencies: 14 agencies served by sewer systems distributing 115 gpcd, 27 agencies without sewer service distributing 88 gpcd. Cutting across the sewer system groupings are economic status of the population and nonresidential water using activities, other than industrial. Apparently the lack of public sewers as a cause of lower domestic demands or as an associate of the lack of lawn sprinkling on large plots is not manifested in northern or western Nassau county. The concentration of economic and public activity along the central tracks of the Long Island Railroad is reflected by the relatively high per capita distribution in central Nassau county.

b. Monmouth County resorts. -- Along the eastern coast of Monmouth county summer resorts add summer peak demands. Monthly water data reveal that more than double the amount of water is distributed in the maximum month than the minimum month. Since the added summer population is often not reported by the water agency, while the added water is, per capita distribution is 115 gpcd. Consequently per capita distribution is 20 to 30 percent higher in these sixteen agencies than correlations with land use and other factors suggest.

Measurement of Change in the Pattern of Water Distribution

Quantification of change in the distribution of water requires the measurement of change of its two components: population served and per capita distribution. The New York Metropolitan Region graphically illustrates the effect of population movement on water distribution change. At the county scale a Spearman rank correlation was computed between population change 1950-1960 and water distribution change 1961-1964. The correlation was .98. Thus, if per capita distribution had remained the same, change in water distribution could be measured through population change.

However per capita distribution has been changing. Specifically, empirically determined coefficients, with one exception, suggest a clear operating premise: the higher the per capita distribution in the base year, the lower the rate of growth in the recent past. The exception is the group of agencies serving areas with no sewer systems. These exhibited the lowest per capita growth rates. Due to the limitations or the historical data, the growth rates were determined for groups, rather than single agencies and only for the 226 agencies serving more than 1,000 persons.

TABLE 3 -- Per Capita Growth Rate Coefficients

GPCD Agency Size Class	Annual Growth Rate
more than 150	.44
100-150	.87
less than 100	
with sewers	1.12
without sewers	.32

A theoretical basis for the growth rates is the concept of the self-limiting mechanism, which has been observed and applied to many growth phenomena, including population. In the context of water distribution in the NYMR, the coefficients reflect high growth rates in suburban areas, low growth rates in core areas. Specifically, since World War Two formerly low per capita suburban areas have experienced growth in high water consuming single family homes, shopping centers, and some industries. Conversely, high per capita core areas have begun to level off due to the change from single family to multiunit structures and the slower growth of industry and commercial demands in their service areas. The low per capita growth coefficient of agencies without sewers reflects a combination of factors constraining growth.

Requirements for Water in the NYMR: 1985

Estimates of future water needs attempt to view the future based on present knowledge of foreseeable developments and relationships in the past. In the past, people and activities, and consequently water distribution, were concentrated in and in the vicinity of core areas. However, in the recent past, high population and per capita growth have been associated with suburban areas. With the general trend noted, estimating future requirements involves projecting population served and per capita demands.

The author views estimates as a forecast of what may occur if a number of specific assumptions materialize. Resulting from specific assumptions, the estimates lend themselves to alteration as conditions change and new data and factors become available.

Two basic assumptions were immediately made: (1) no major wars or economic catastrophes would occur, and (2) scientific ingenuity would not produce another set of heavy water using appliances to rival the plastic hose and the water cooled air conditioner.

Analysis of population estimates and per capita data suggested a range, rather than a single set of estimates. Population is difficult to project on the county and smaller municipal scale due to a lack of intraregional migration data. Consequently estimates by local planners at the county scale differ by as much as fifteen percent. Projections at the municipal scale are as much as twenty-five percent divergent. Moreover, there are indications that per capita growth might level off in the immediate future. Briefly, the added costs of water and waste treatment might reduce industrial and commercial use. And the replacement of single family with multiunit structures might reduce domestic per capita demands.

Thus, a high and low set of water requirements have been estimated. The high estimates assume accelerated population growth rates or decelerated population declines and a linear extrapolation of the present per capita growth rates into the future. The low estimates assume more conservative population changes and the immediate leveling off of per capita growth. On the agency scale, the low set of assumptions are modified to distinguish between types of water consuming agencies and the differential application of the per capita leveling off process. And two other assumptions are added concerning the installation of public water and sewer systems.

Applying the polar assumptions at the county scale produces a range of estimates for 1985: a low estimate of 2.66 bgd, a high estimate of 3.41 bgd. Relative to present distribution, the low estimate projects a twenty-five percent increase, 480 mgd, the high estimate a fifty-six percent increase, 1.230 mgd. The second, equivalent to the present distribution in the City of New York, is likely to occur if present trends continue.

As expected the brunt of the added demands are likely to fall on the peripheral areas of the Region. Dichotomizing the Region as in Figure 2 indicates the broad extent of the expected change. In 1963, the peripheral areas (dots) distributed twenty-three percent of the water. In 1985, they are expected to distribute about thirty-seven percent. Relative to 1963, this implies between an eighty-five and one hundred and fifty-four percent increase. Conversely, demands in the core areas are likely to increase only between five and thirty percent.

TABLE 4 -- Estimated Water Requirements in 1985

Area	Distribution 1963 Mgd	Expected 1985 low	Expected 1985 high
Core	1642	1755	2157
Peripheral	494	901	1256
Total	2136	2656	3413

Thus, the direct implication of urbanization is the markedly different requirements for water within the Region. In turn, these requirements are likely to have a direct effect on the present patterns of distribution in the Region. Small agencies on the Region's periphery with little capital for expansion, are likely to be overwhelmed by the demands. Conversely, large core agencies may have investment capital and perhaps excess water. Under the hypothesized conditions three possible changes are probable in the peripheral areas:

(1) the creation of county super agencies; (2) the movement of core agencies into the vacuum; (3) the expansion of the present systems through interconnection with core agencies. The first step has already occurred in Morris and Suffolk counties, the second in Rockland, Bergen, Fairfield, Somerset, and Middlesex counties, and the third in the densely developed portion of New Jersey and in Westchester County.

The change has often met stiff resistance. In Morris County, New Jersey municipalites with existing systems have withdrawn from the County Water Authority. In the second group the expanding private agency has usually been able to purchase existing systems. When it has not, as in Nyack in Rockland county, court cases have resulted. The interconnection of all systems and the transfer of water as requirements change has been stifled by contracts calling for inflexible fixed transfers over fixed periods.

However, resistance is likely to crumble due to the magnitude of the demands. Thus, urbanization in the NYMR implies overall and intraregional water requirements which, in turn, are likely to force radical changes in the present water distribution patterns.

Notes

[1] The research has been supported by the Office of Water Resources Research, USDI, grant No. 14-01-0001-1583.

[2] Walter L. Picton, Water Use in the United States: 1900-1980, Washington: U. S. Department of Commerce, 1960, p. 6.

[3] Ralph Porges, "Who Gets How Much of What Kind of Water From Where and Whom?" Water Works Engineering, 110, 134, (February, 1957).

[4] This map is a generalized version of a detailed agency map.

[5] Metcalf and Eddy, Hazen and Sawyer, Malcolm Pirnie Engineers, Comprehensive Public Water Supply Study for the City of New York and County of Westchester, State of New York, Department of Health, April, 1968, p. 20.

GERANIUMS, JUNKYARDS AND GEOGRAPHY:

ENVIRONMENTAL QUALITY AS A PUBLIC GOAL

IN NEW YORK STATE

Charles C. Morrison, Jr.
New York State Natural Beauty Commission

As much as my work deals with "implications of urbanization," I would have liked to have been in the last session on Geography in Government, too. Having worked successively for the City of New York, the Federal Government, and New York State, I feel like saying something on that subject. After completing graduate work I was with the Regional Plan Association for a year and then joined the staff of the American Geographical Society for five years. But the past seven years have been spent in government employment and it has been very satisfying.

Perhaps it would be practical to proceed by straddling the topics of both sessions. Certainly geography and geographers in government have something to do with urbanization. And maybe they should have more to do with it!

We have seen the perennial debate over the role of the university in our society whip up to maelstrom proportions once more. This time the catalyst has been student activism over the strong ties between the Academic and Military Establishments and -- the students say -- too little attention by the universities to the major issues of social and economic injustice in the United States. Whether or not the nature of these relationships is a symptom or a cause of student unrest, there can be little doubt that this is but a variation on a much older theme. In another, quieter, time the polarizations might have been expressed as being between liberal arts and vocational or professional training. Or, between teaching and research or administration. As in many other situations, however, it would seem that such polarizations are unwarranted and misleading. Choices are seldom black and white, but rather a matter of emphasis.

James A. Perkins, president of Cornell University, recently likened the modern university to a triangle with equal sides --

teaching, research, and public service. Mr. Perkins sits on the teaching side of the triangle. So he put that first. I am sitting on the public service side. However, I am doing research and, as a communicator of information, I am teaching.

This confluence is essentially what I had in mind when, as chairman of the AAG Placement Committee, I wrote in the April 1966 issue of Jobs in Geography, that the fundamental relationship . . . .

> ". . . between research . . . teaching, and the application of . . . knowledge . . . to the resolution of human problems is accepted by most geographers. Few geographers would argue that their professional status would be endangered, for example, if they participated in social, economic, or physical planning functions in public or private agencies on a consulting basis. Indeed, most would welcome the chance to become so involved, recognizing that there frequently are opportunities in these endeavors to test their theories 'in the crucible,' thereby opening the way for their elaboration, amplification, and general interprofessional and public acceptance.
>
> A logical extension of these thoughts is that full-time employment in the applicatory end of the research-teaching-application trinity is no less dangerous to one's standing as a professional geographer than full-time employment in the teaching end. There are some public or private planning jobs, for example, which offer a better opportunity for theoretical and applied research than some university or college teaching jobs. Moreover, there even are some planning jobs which offer better teaching opportunities than some teaching jobs -- if oral and written transmission of professional knowledge to the public may be counted as teaching.
>
> But the main point to be made here is that geographers generally recognize the interdependencies of these functions and acknowledge that excessive concentration on any one of the three functions to the exclusion of the others is likely to result in professional sterility by way of isolation from the mainstream of society's activities and purposes."

In 1962, Gilbert F. White noted that: "The contributions which geographic thought can make to the advancement of society are relatively few, simple, and powerful . . . They are so powerful that failure to recognize them jeopardizes the ability of citizens to deal intelligently with a rapidly changing and increasingly complex world."[1] In the concluding article of a symposium on "Critical Issues Concerning Geography in the Public Service," to which Dr. White's remarks constitute an introduction, Edward A. Ackerman pointed out that "a profession as a whole may even have a certain obligation to see that the knowledge which it accumulates is made meaningful in terms of public policy."

I would go further than that. A profession such as geography definitely has a responsibility to become heavily involved in public policy. However, we are not involved enough at present. To be sure, geographers are working on such diverse matters as census projects, remote sensing, and defense intelligence. They are applying the particular approach of geography in other ways to society's problems. But as far as any direct and concerted effort to influence public policy formulation is concerned, the profession is still resting on the laurels of a few star performers like White and Ackerman and an older generation of geographers who were active in the TVA, the National Resources Planning Board, and the economic development work of a decade ago.

We can't keep talking about what Isaiah Bowman did at the end of World War I. Yet, the profession as a whole had done little on a systematic basis to overcome the stereotyped image of the geographer as one of those social scientists ". . . who can always raise questions as to how valid an approach or decision is, but is seldom capable of giving usable assistance to the planner or decision-maker in the tougher moments of responsibility."[2]

Perhaps the reason for this poor image lies with the diversity of our interests. As geographers we make good general lists but we find it hard to compete as specialists in all of the subjects about which we generalize. The fault also may be with our lack of a substantial body of theory, geography being an "approach" rather than a distinct discipline.

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[1] White, Gilbert F., *et al.*, "Critical Issues Concerning Geography in the Public Service" (symposium), *Annals of the Association of American Geographers*, Vol. 52, Sept. 1962, No. 3, pp. 279-298.

[2] *Ibid*, p. 293.

Or perhaps the fault lies with our Association. For years there has been an obvious need to make the relevant works and skills of geographers better known to private business and industry, as well as to public agencies, but no great effort has been made in this direction. The profession and the Association have been almost entirely oriented toward the academic world.

To a certain extent, this is a public relations problem. There are various ways of improving the geographer's image. One of the avenues that could be utilized to better advantage is that of job development. The Placement Committee could do more in this regard. The Geography and Government Committee could do more --especially if it expanded its horizons beyond the federal government to include state and local government. But, this kind of problem needs strong central direction and staff support; volunteer committees can't do it all.

If the AAG did undertake an intensive public relations job, through one avenue or another, would the colleges and universities be able to fill the increased demand for professionals? How would they respond?

In my experience, university geography departments have done very little to develop manpower for positions outside of academic circles. Most of them tend to discourage non-academic employment -- by default and more directly by overemphasis on academic employment as the pinnacle of professional achievement. Perhaps this is a reflection again of the disengagement of the profession as a whole. In any case one of the most unfortunate results of the situation is that students who do not choose an academic career usually disappear from the professional scene. They are not encouraged to continue thinking of themselves as geographers. Disaffection and disinterest in the profession usually follows.

Broadening the base of professional involvement and responsibility seems to be a matter of moving ahead on several fronts simultaneously rather than choosing one course of action over another. I am not suggesting that any area of present professional activity should be weakened or de-emphasized. We need to "teach geographers to teach geographers." But strong positive action is needed by the major departments and by the Association and its various Divisions if the profession is to have a direct role in shaping our society. If such action is not taken the viability of geography as a separate disciplinary entity will be impaired even more than it is at present.

If geography is basically concerned with areal differentiation of the earth, focusing particularly on man-land relationships, I know of no better place for geographers to cross lines between the academic and governmental communities than in matters affecting environmental quality. Commissioner Harold Howe, of the U.S. Office of Education and life trustee of Yale University, recently told his fellow alumni that the chief issues demanding attention by universities included (1) the dilemna of the cities, (2) the man-made threat to man's natural environment, (3) the racial question, (4) poverty, (5) the population explosion, and (6) the crises of management and communications. The issues of environmental quality cut across most of these items but they zero in on number two especially.

Geographers are doing research on various aspects of the natural and man-made environment. They are investigating some of the problems and issues arising from man's conflicting uses of his environment. They are working on various aspects of urbanization and settlement, environmental perception, water resources or other natural resources, outdoor recreation, or land use, for example. But, -- again -- too few are involved in policy matters or are attempting to exert any influence over policy or decisions on individual developmental projects. And often their research is ill-conceived, sterile, and ineffectual because of this lack of involvement. They seem to feel that their scholarly objectivity will be undetermined by making recommendations. So they go only so far and then stop without coming to grips with knotty issues.

Those of you who are not familiar with the semantics of natural beauty probably may tend to confuse it with "beautification" or with the 1965 Federal Highway Beautification Act or with "Ladybird's Program." I sometimes wish it were that simple. In actuality, natural beauty may be defined as pertaining to the quality of the total environment, including both man-made and natural aspects. The emphasis of the movement or approach -- for that is what it is rather than a distinct subject area in the usual program sense -- is on preserving and enhancing those natural values without which man's life on this planet would be either intolerable or impossible. To preserve natural values one also has to be able to influence man's impact on his environment -- the pattern of urban growth and development, the utilization of natural resources for raw materials and for purposes such as outdoor recreation, or as mediums for disposal of various wastes.

In effect, natural beauty represents a merger of some of the traditional interests of the fields of conservation and planning so as to obtain a more comprehensive approach to control of all aspects of our environment. It is also a response to the groundswell of public concern and civic interest that has risen during the past decade over the increasing degradation of our environment in the face of rapid uncontrolled land development and technologic change. Natural beauty is not a new program. It is a new response to persistent old problems and to a few new ones that have cropped up recently. It represents a renewed emphasis on natural values and quality in design that cuts across most of our on-going activities affecting the environment.

One of the best guides to the different subject areas covered by natural beauty is the 782-page proceedings of the 1965 White House Conference on Natural Beauty. Or you might look at the report due to be published this month by the President's Council on Recreation and Natural Beauty. This is titled <u>From Sea to Shining Sea</u> and represents the first comprehensive and definitive report on the quality of our environment since the White House Conference.

About 35 states have had Governor's Conferences on Natural Beauty. New York had one in February, 1966 at the Biltmore in New York City. The summary is available. In each state, there have been a variety of subsequent actions. In New York, a principal response by the Governor and the Legislature was the creation of the Natural Beauty Commission.

The Commission is structured somewhat like the President's Council in that it is an inter-agency body. But the similarity ends there. The Commission was established in the Office for Local Government and the Commissioner of that Office serves as Chairman. Thus, in addition to a coordinating role among state agencies, the Commission has a responsibility to coordinate state and local activities and promote natural beauty programs at the local level, not only through local governments but also by working with private organizations, civic groups, and individual citizens.

The other members of the Natural Beauty Commission are the Commissioners of Commerce, Conservation, Housing and Community Renewal, Health, General Services, Transportation, the Director of the Office of Planning Coordination, and the Chairman of the Council on the Arts.

The enabling act which established the Commission specified the following principal duties:

1. Develop policies and programs to preserve and enhance the natural and man-made beauty of the state and encourage, facilitate and assist in the coordination of the activities of the various state agencies in furtherance of such policies and programs. This shall be done after consultation

with local governments, and private individuals, groups and institutions.

2. Advise, encourage and assist local governments in the full utilization of their powers to preserve and enhance natural and man-made beauty.

3. Conduct and coordinate studies, surveys and inventories of the natural beauty resources within the state.

4. Designate scenic sites, areas and highways in the state and develop programs for their preservation and enhancement.

5. Promote the application of aesthetic considerations in the location, design, construction and maintenance of state lands, projects, and buildings.

6. Serve as a clearinghouse for information about these matters.

The Commission also is empowered to receive gifts, grants, and bequests in accord with its purposes, upon approval of the Governor.

So far we have been talking in rather general terms. Perhaps if I set forth a list of some of the kinds of environmental conditions in which we have an interest I could point this up quickly. In considering this list, please keep in mind that the Commission's member agencies, other state agencies, federal agencies, private organizations, and various local governments all have interests in these matters. The Commission's central staff -- which is now quite small -- is expected to encourage action on these matters. It does not expect to resolve all environmental difficulties overnight!

-- nature centers; outdoor or environmental education programs

-- preservation of scenic areas and open space

-- preservation of wetlands and marshes, other natural areas and natural landmarks

-- preservation or restoration of historic buildings or blockfronts, canals, covered bridges, old cemeteries, monuments, and other landmarks

-- adequate park and recreation areas and facilities or encroachment on such areas

-- disposal of refuse, garbage, sewage, waste oil, storm drainage, nuclear and industrial wastes, solid wastes (including junk cars)

-- indiscriminate use of pesticides or other chemicals

-- open storage yards and unsightly industrial areas

-- architectural design or various aspects or urban design

-- preservation of agricultural lands

-- coordinated design of "street furniture"

-- noise abatement

-- abandoned and dilapidated buildings

-- proliferation of unattractive signs and billboards

-- substandard residential areas

-- litter control and cleanup

-- overhead electric distribution and transmission wires, unscreened and poorly located substations

-- unsightly and uneconomic downtown commercial areas or commercial strips

-- shade trees and landscaping

-- poorly maintained public and private lands and buildings

-- unregulated suburban development (residential and commercial)

-- location or design of public features, buildings, highways, or other public works

-- tree removal; excessive deforestation

-- soil and beach erosion, soil pollution, reforestation, flood control

-- regulation of surface mining, borrow pits

-- scenic roads, parkways, and tourways systems

-- urban and rural beautification

-- regulation of mobile homes and trailer camps

In order to be comprehensive and to avoid semantic difficulties, some of the items on this list overlap, while others are quite ambiguous. However, I think you can decide from this brief description whether or not this work should be of interest to the geography profession. There certainly is plenty of opportunity for involvement with environmental problems in teaching, research, and in application.

(There is no need to make any esoteric distinctions between "basic" and "applied" research. All research is pragmatic in the sense that it has a "pay-off," however obscure or long-range. Some environmental problems are going to be solved only after very prolonged research and even then the answers may come from seemingly unrelated fields.)

It does not appear to be necessary to catalogue the various activities we have started or expect to start in the Natural Beauty Commission. This information can be obtained from our various reports and publications as they are released. Some of it can be surmised from the duties that are set forth in our enabling act. It is enough to say that the Commission has made a beginning and it has excellent potentials. I do want to mention that we are cooperating with several universities and colleges in a limited way at present, and I see great possibilities for expanding this aspect of the program.

One thing is certain. Environmental quality as a public goal is here to stay. Creation of the Commission represents one response at the state level to the need to take concerted action to resolve environmental problems. It also shows that there is increasingly widespread understanding that problems of the environment are interrelated and need to be viewed comprehensively.

But, aren't the kinds of environmental relationships with which the Commission is concerned largely identical with those that geography has long explored? After all, Harlan Barrows defined geography as human ecology in the 1920's! It seems to me that the interdisciplinary view of the geographer has special pertinence here. This is where the action is. But where are all the geographers?

MAN AND WATER POLLUTION

Ronald Stewart
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State University of New York at Albany

In every age, in every society, there are few key words which represent the phases through which that age and/or society passes. Today, pollution is a watchword, or if we wish to encompass pollution and its effects, we often use the term ecology.

Tonight I would like to mention a program which encompasses ecology, pollution, geography, limnology, atmospheric science, biology, economics, and take your choice. This is the IBP, the International Biological Program. The IBP is designed to take an intensive look at a series of biomes. This will include an analysis of ecosystems, phenology, biogeography of the sea as well as studies on human adaptability dealing with migrant populations, Eskimos and nutrition.

To bring this program closer to home we may consider the Lake George basin, 50 miles north of this campus. The IBP has designated this area as a focal point for ecological studies. Lake George is 32 miles long, an average of 1-1½ miles wide and has an average depth of 60 feet. The Lake exchanges about ten percent of its volume annually through an outlet at the northern end.

SLIDE 1: The basin is outlined by mountains which tend to limit the runoff area and affect the wind direction and speed. The aerial photograph was taken looking northward from the southern end of the Lake. (All aerial photographs were taken from a research aircraft operated by the Atmospheric Sciences Research Center, State University of New York at Albany. The pilot was Mr. Ralph Markson.)

SLIDE 2: The Narrows in Lake George, showing some of the islands which are used for camp sites. There are over 170 islands in Lake George, most of which are owned by the State.

SLIDE 3: The Narrows with Northwest Bay to the left and Tongue Mountain in the foreground.

SLIDE 4: A view of the shoreline with some residential and commercial development.

SLIDE 5: Heavy residential and commercial development of the southern end of Lake George. It is this area of the lake which has begun to age, or go through early stages of eutrophication.

SLIDE 6: A beer can on the bottom of the Lake. Each Monday morning there are a dozen or so bottles and cans found in this lakefront area where we dock our boats. Picking up this trash has been one of the more successful aspects of our research program!

SLIDE 7: A 55 gallon drum rusting on the bottom of the Lake. On slides six and seven the clarity of the water was most evident. For fifty years the residents of Lake George have organized to protect this Lake through political pressure, legislation and at times, "physical encouragement." Today, despite all these efforts the lower one-third of Lake George has begun to show the effects of eutrophication, or aging.

Research plans call for 15-20 investigators to study the biological, chemical and physical aspects of the Lake George basin. With the use of systems analysis it may be possible to judge the future effects on the basin of population increases, industrial development, etc.

SLIDES 8-9: Diffraction colors on the water caused by the presence of gas and oil from outboard motors on Lake George. Approximately 40,000 gallons of gas and oil are discharged into the southern half of Lake George each year by two-cycle outboard motors. Inboard bilge waste is also discharged but no estimate of this quantity is available.

SLIDES 10-17: Diffraction colors on the sand caused by a layer of oil. This layer covered several hundred feet of shoreline after a period of heavy rains. It appeared that the oil was discharged from nearby storm sewers. About 350 million gallons of used motor oil must be disposed of annually by over 200,000 gas stations. Sometimes this waste oil is dumped into storm sewers even though it is illegal to do so. Oil such as this marks boats, coats bathers, and creates a smell and taste which renders water useless for drinking. It also uses up oxygen which would normally aid in purifying the water and supporting aquatic life.

There are many individuals and organizations involved in the IBP studies on Lake George. These next few slides will provide you with some idea of the methods which we are either using at this time, or plan to use in the future.

SLIDE 18: A calibration tank designed and built by Mr. Frederick Tallman of the Department of Atmospheric Science, SUNYA. This tank is used in the calibration of a heated thermistor current meter which will be used for measuring vertical and horizontal motions. The tank has also been used to demonstrate standing waves, or seiche, which displace large masses of water in Lake George (and other lakes).

SLIDE 19: An aerial view of the boat used by the New York State Department of Health for dye diffusion studies on Lake George. Usually Rhodomine B or a similar form of dye is discharged into the water at a known concentration. Then a fluorometer and pump system samples the dye as it diffuses vertically and horizontally. The Rensselear Polytechnic Institute (RPI) and the State University of New York assisted in the program.

SLIDE 20: An aerial view of the RPI boat under the command of Mr. Stephen Wilson, Department of Geography, SUNYA. This boat was studying the thermal structure of the lake during the dye diffusion studies.

SLIDE 21: A rotating room designed and built under the direction of Dr. Ralph Rumer, Department of Civil Engineering, State University of New York at Buffalo.

SLIDE 22: A model of the Lake Erie set-up inside the rotating room. This type of model provides information on flow patterns, retention time, seiche and other motions relevant to lake dynamics. A similar model of Lake George is being considered as Dr. Rumer has offered the use of this rotating room for our studies.

SLIDE 23: The 18 foot aluminum cathedral hull boat operated by the Atmospheric Sciences Research Center and the Department of Atmospheric Science, SUNYA. All instrumentation associated with the use of this boat is portable and may be set up for each run. This same boat has been used on Lake Ontario for physical limnology studies.

SLIDE 24: The Salton Sea as viewed from a Gemini capsule. Naturally occurring materials provide a mosaic of the current pattern. Infra-red studies are also becoming simpler to perform and can provide information on the current patterns.

The physical studies on Lake George in which SUNYA has been most interested include surface and internal waves, Langmuir circulations and heat budget including applications to the problem of thermal pollution.

SLIDE 25: Streaks (foam lines) which are often surface manifestations of Langmuir circulations.

SLIDE 26: A schematic of Langmuir circulations. These organized circulations are the most important means by which heat is transferred downward in a lake. The width of these circulations may range from a few centimeters up to fifty meters. The downwelling has been measured at 8cm/sec and may be greater during periods of instability (when the surface waters are cooling from any given temperature down to 4° C.)

SLIDE 27: A recording of the surface seiche on Lake George, N. Y. These data are a necessary part of any current studies which are carried out on lakes. The periodic oscillations must be accounted for when calculating the currents which are non-periodic. The seiche currents in the Narrows displace water mass ± 0.3 km from its original position. In terms of currents this represents an average motion of 6 cm/sec which must be accounted for in diffusion studies, etc.

SLIDE 28: The position with time of the 14° C and 16° C isotherms in Lake George. The oscillations of the thermocline show up as periodic internal waves represented by the movement of the isotherms. The oscillations may have an amplitude of 5-6 meters. This represents another method of mixing and heat exchange which is of interest in lake studies.

SLIDE 29: A mock-up of the activities at Lake George which are supported by the Office of Water Resources Research, The

Department of the Interior. This unit is the floating probe designed and built by Glenn E. Myer, Department of Atmospheric Science, SUNYA. It is designed to sample air and water temperature at several positions, record wind velocities and relative humidity. These data are being used to determine the cause of Langmuir circulations and measure the mixing associated with them. The probe is launched from a pontoon barge which also contains all the recording equipment.

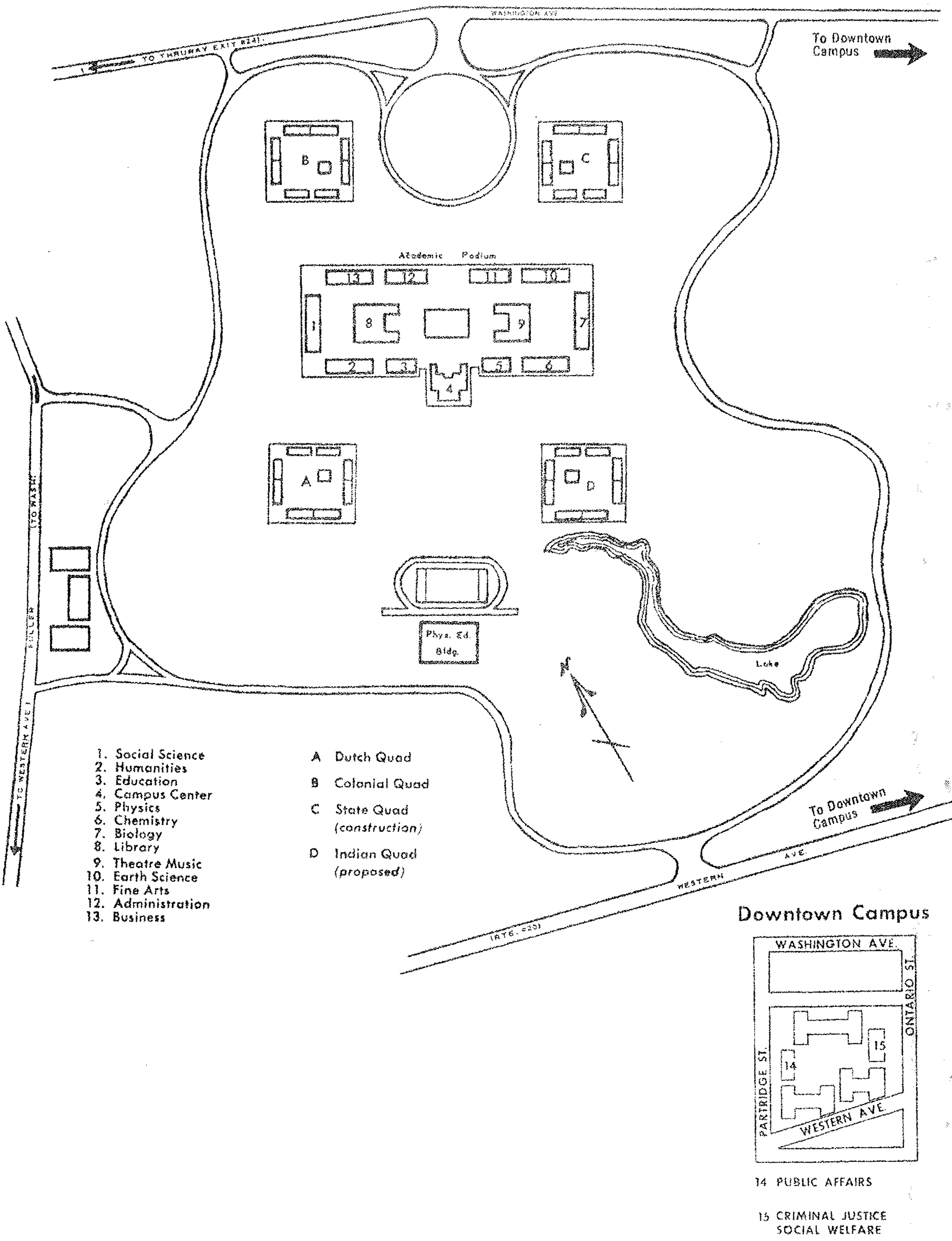
SLIDE 30: Lake George Scenery.

I have discussed some of the IBP studies which are either ongoing or planned for Lake George. The biological and chemical studies, which I have not stressed, will be carried out by other departments and organizations. All of these programs need help. I have not mentioned research concerning water resources planning and management or the socio-economic aspects of water resource problems. For fiscal year 1967 the Office of Water Resources Research has allocated two million dollars concentrating on such problems.

SLIDE 31: Lake George Scenery.

The winter population of Lake George village is about 1,000 persons (1965). The summer population is 10,000 with as many as 50,000 transients in the Lake George basin on a weekend. Projection of the population statistics show that the winter population in 2020 is expected to be over 3,000 and the summer population about 17,000. No estimate of the transient population is realistically possible. Today Lake George is reasonably clean considering the population pressures that are on this lake. The chance of Lake George remaining pure depends upon the local residents continuing their efforts, and increasing them as the population increases. The International Biological Program can help by providing needed data which will show the changes expected over the next few decades. This will take a lot of planning and a well-organized research program. Twenty staff members from universities and government agencies are getting involved now. Another forty attended an organization meeting to discuss their ideas. <u>One</u> was a geographer. Do I hear <u>two</u>?

STATE UNIVERSITY of NEW YORK at ALBANY
Uptown Campus



THE ROLE OF MAPS IN EARLY AMERICAN GEOGRAPHIES*

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The Problem

Through the colonial period to the end of the nineteenth century, the status of geography in American elementary and secondary schools underwent marked change. Although instruction was given in the subject in colonial colleges and in the more advanced colonial schools or academies, it was not until after the American Revolution that geography was commonly offered as a separate school[1] subject. By the 1830's, it was generally agreed throughout the United States that geography had become one of the most important school subjects, a position it held for the remainder of the century.

Direct accounts regarding the early history of curricular evolution in the United States are rare, and information regarding the metamorphosis of school geography is necessarily drawn from indirect evidence.

One way to ascertain the nature of early school geography is to examine contemporary geography textbooks. As Dryer suggests,[2] the importance of the textbook, particularly as a measure of school pedagogy, rests in the fact that it serves as the prime source in determining the type of instruction given.

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*I should like to thank Professor Richard E. Dahlberg, Syracuse University, for reading the manuscript.

[1]The term "school" as used hereafter in this study includes not only public schools, but private schools and parochial schools as well.

[2]Charles Redway Dryer, "A Century of Geographic Education in the U. S., "Annals of the Association of American Geographers, Vol. XIV (September, 1924), p. 119.

To be sure, a number of significant studies have appeared which focus upon geographic education and textbooks in treating many aspects of early American geography.[3] Yet, almost no attention has been devoted to the maps used in geographic education during this era. As a result, very little is understood regarding the nature of such maps and, particularly, the pedagogic role that they played. Accordingly, this study was undertaken to characterize this role and thereby enlarge our knowledge of American school cartography.[4]

The Early American Era

On the whole, early American geography textbooks were written by non-professional geographers. A good many writers were educators with interests in all aspects of pedagogy, several were members of the clergy, and some were even physicians. The era begins in 1784, when the first geographies[5] were written by two of these non-professionals. By the 1890's, however, most geographies were being written by professionals. Because a definite shift occurred in traditional views,[6] we have chosen this juncture to mark the end of the era.

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[3]These include: William Warntz, Geography Now and Then (New York: American Geographical Society, Research Series No. 25, 1964); John R. Sahli, "An Analysis of Early American Geography Textbooks from 1784 to 1840" (unpublished Ph. D. dissertation, University of Pittsburgh, 1941); Ned Culler, "The Development of American Geography Textbooks from 1840 to 1890" (unpublished Ed. D. dissertation, University of Pittsburgh, 1945); Charles Redway Dryer, "The New Departure in Geography," Journal of Geography, Vol. XI, No. 5 (January, 1913), pp. 145-51; and Dryer, "A Century of Geographic Education in the U. S.," op. cit., pp. 117-49.

[4]Over two hundred early American geographies and school atlases were examined. The bibliographical compilation is discussed and presented in: Michael Frederick Antonelli, "The Role of Maps in Early American Geographies: 1784-1890 (unpublished M. A. thesis, Department of Geography, Syracuse University, 1969), pp. 9-13, Appendices A, B, and C.

[5]Robert Davidson, Geography Epitomized; or, A Tour Round the World (Philadelphia: Printed and sold by Joseph Crukshank, 1784); Jedidiah Morse, Geography Made Easy (New Haven: Printed by Meigs, Bowen and Dana, 1784).

[6]See Dryer, "A Century of Geographic Education in the U. S.," op. cit., pp. 124-26.

The Format of Early American Geographies

Eighteenth and nineteenth century American authors and publishers of geography textbooks outfitted their books with maps according to two schemes. That is, maps were either included within the texts themselves or were bound separately and accompanied the treatises as school atlases. These methods form a cyclic pattern which conveniently divides the era under consideration into three fairly distinct periods, thereby facilitating the organization of this study. Moreover, they represent textbook formats which clearly mirror the state of contemporary knowledge and technology.

The Influence of Contemporary Conditions

This inquiry into the role of maps will consider the trends concerning the use of contemporary school geography textbook and school atlas maps, their content, and the methods by which the maps were reproduced. At the outset of this investigation it became evident that each of these three aspects reflects various conditions apart from the state of contemporary knowledge and technology. They also reflect the prevailing educational and even political philosophies.

Ethnocentric attitudes were expressed both in the text and choice of maps of the first period geographies of Jedidiah Morse. The educational philosophy of Johann Heinrich Pestalozzi (1746-1827), a famous Swiss educator, were manifest in the writings and use of maps in the texts of James Monteith,[7] a writer of the third period (Fig. 1). In other words, the maps that accompanied contemporary geography textbooks are expressive of the total context in which they were produced. Thus, a study of these maps informs us about many interrelated aspects of this segment of American education.

The First Period: 1784-1814

The first period, 1784 to 1814, is characterized by geographies of small format containing few, if any, maps. This was the incubation period of geographic pedagogy in America. The first generation of American geography textbook writers was greatly restricted in its use of maps because few maps were available.[8] There is no doubt that the majority of these authors realized the importance of maps. Many, however, relied on what they referred to as the "artificial globe."

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[7] See James Monteith, Monteith's Manual of Geography (New York: A. S. Barnes & Company, 1873).

[8] Jedidiah Morse and Sidney Edwards Morse, A New System of Geography, Ancient and Modern (26th ed.; Boston: Richarson & Lord, 1826), p. iii.

Of the limited variety of maps that existed, many were either too crude for effective use, too expensive to be practicably reproduced, or incomplete because of the limited extent of knowledge. The level of map reproduction technology was still at a relatively low state. Data that were available were necessarily reproduced from either woodcuts or copper engravings that had to be worked by hand -- methods not unlike those employed in the early fifteenth century when the processes were first used. The resulting maps either lacked fine definition, or were costly, for detail was next to impossible on wood-cuts and frequent replacement of the easily-worn-down copper engravings was required.

Engraved maps had to be printed separately from the text, which was printed by letter press -- a fact that had important ramifications. For instance, in printing maps from engraved plates there was no need to conform to a rigid page size as in the case of letterpress printing. Consequently, a greater range of map scales could be used for different maps in the same book, as evidenced by the fact that some maps were folded while others were not.

Thus, several considerations limited the number of maps appearing in geography textbooks of the first period. If maps were included within the texts, they seldom were mentioned, and even then only in the most general terms.

Of the maps that did appear in first period geographies nearly all were either "political" or "physical." Characteristically, the wood-cut maps were of page size (averaging 4- x 7- in.); the engraved maps were of various sizes and some were folded into the textbook.

These maps, in a very broad sense, were reflective of a nationalistic bias in the arrangement and emphasis of content. As Monica Kiefer notes, "new geographies appearing after the revolution reflected the national pride of American writers and their faith in the future of their country."[9]

Generally, first period American geography text writers adopted the style and format of English writers. Their primary intention was to reduce the size and cost of extant English geographies. Although the new books acquired a remarkable similarity, they differed significantly in emphasis, mirroring ethnocentric attitudes. Eventually they forced English geographies into the background.

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[9] Monica Kiefer, American Children Through Their Books (Philadelphia: University of Pennsylvania Press, 1948), p. 153.

The leading first period geographer, Jedidiah Morse, "designed" a new edition of his text, The American Geography,[10] to give a "view" of Europe, Asia, and Africa, as well as the Americas. Yet, only one map of a total of twenty-five depicted a non-American area. According to Morse, the geography of Europe and of Asia was well known to educated Americans. However, they were ignorant of the geography of their own newly formed nation. He remonstrated that Americans "have humbly received from Great Britain, our laws, our manners, our books, and our modes of thinking; and our youth have been educated, rather as the subjects of the British king, than as the citizens of a free republick."[11]

Morse can be credited with being the first American geography writer to express an awareness of the value of maps in geographic study.[12] And by the time his third geography treatise[13] was readied for the press it included a representative discussion of maps characteristic of first period geographies. The author mentioned,[14] for example, that "maps are a representation of the surface of the earth, according to the aforementioned natural division; on them are also marked the political divisions, which will be hereafter mentioned." He also warned his young scholars that the top of the map was always north, while the bottom was south, providing, of course, one was looking at the map "properly," and the east was on the right-hand side, while the west was on the left.

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[10] Jedidiah Morse, The American Geography (new ed.; London: Printed for John Stockdale, 1794). Because of the large number of maps of the United States that it contained, this book, although not regarded as an atlas, was the first entry listed under the category of "General Atlases of the United States." See Philip Lee Phillips, ed., A List of Geographical Atlases in the Library of Congress, with Bibliographical Notes, Vol. I (Washington, D. C.: Government Printing Office, 1909), p. 750.

[11] Jedidiah Morse, Geography Made Easy (2d ed.; Boston: Printed by Isaiah Thomas & Ebenezer T. Andrews, 1790), p. v.

[12] Jedidiah Morse, The American Geography (Elizabethtown: Jedidiah Morse, 1789), p. vi.

[13] Jedidiah Morse, Elements of Geography (Boston: Printed and sold by I. Thomas & E. T. Andrews, etc., etc., 1795).

[14] The discussion was confined to approximately three-quarters of p. 36.

While Morse never concealed the fact that he was affected in his handling of geography by the writings of English geographers, and admitted borrowing freely from them,[15] he did little to establish a rationale for his choice of material. However, the competitive situation which soon obtained (nearly two dozen Americans are known to have produced geographies during this period) compelled American writers to become self-critical and to give good reasons for the textural organization and purpose of their geographies.

By the end of the period it was generally agreed that map study was a vital aid to the teaching of geography. This feeling was most strongly stated in a "remembrancer" prepared in 1812, that was little more than an outline embodying "the whole great science."[16] Benjamin Gleason insisted that, up to his time, the teaching of geography in the United States had been constrained by insufficient use of maps concurrent with instruction. Continuous reference to maps, he went on to stress, was "absolutely indespensable," because the "eye informs the understanding, and <u>instructions</u> thus fix, upon the mind, the most correct and durable impressions."[17] Two years later, in 1814, the invention of steel engraving enabled map makers to produce large numbers of inexpensive maps, and soon the school atlas, an innovation borrowed from the English, was widely adopted for use in American geographic education.

The Second Period: 1814-1844

The introduction of the school atlas reflects a combination of contemporary conditions. Though geography textbook writers of the first period were familiar with atlases, optimal conditions for the use of the atlas in conjunction with school geographies did not arise until the second decade of the nineteenth century. More useful data were available. On the North American continent, for example, little was recorded of the land beyond the Allegheny Mountains until the explorations of such men as Lewis, Clark, Pike, and Long.

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[15] Among others, J.K. Wright mentions the similarity of his article "Some British 'Grandfathers' of American Geography," contributed to the Geographical Essays in Memory of Alan G. Ogilvie, ed. by R. Miller and J. Wreford Watson (London: Thomas Nelson and Sons, Ltd., 1959), pp. 144-65.

[16] Benjamin Gleason, Remembrancer; Geography on a New and Improved Plan (Boston: Benjamin Gleason, 1812), p. 2.

[17] Ibid.

This information could be reproduced in map form more readily because of the economies arising from the invention of steel engraving. Engraved copper plates wore down after three or four thousand copies were made. Since many early geographies sold well into the thousands of copies, copper engravings did not provide an inexpensive reproduction process. With the use of steel engraving, however, large numbers of well-defined maps could be produced at a low cost. Steel engraved plates could produce literally tens of thousands of copies. No longer was the quality and quantity of maps restricted by printing technology. The resulting increase in the number of maps, in turn, caused them to be bound separately. This facilitated their use, since period geographies were still of the small octavo size (ca. 5- x 8-in. to 6- x 9½-in.), which meant that maps of any larger size would have to be folded.

Thus, the second period authors were afforded an unprecedented opportunity to expand the possibilities for map use by virtue of their abundance. The use of the atlas had two advantages. First, it eliminated the nuisance of folding maps into small octavo-size geographies. Second, it made it possible to increase the number of maps to ten or more. The atlases ranged in size from octavo to quarto (ca. 9- x 12-in.).

The growing awareness of the need to use maps in geographic pedagogy which characterized the latter part of the first period, coupled with the fact that maps were at last available, influenced the ways in which maps were commonly regarded during the second period. Writiers were so convinced of the principle of making sight the medium for conveying geographic instruction that maps became the focal point of nearly all contemporary pedagogical discussion. Several of the more significant innovations related to the role of maps dealt with the use of "interrogatives," the methods of "comparison and classification," and "map construction exercises."

Interrogatives were simply questions on the atlas maps. Authors organized their geographies so that they would be used throughout in connection with atlases. That is, authors provided exercises which required pupils to answer map questions ranging from calculating time, to finding places, to establishing distances. "It is from the Atlas," Daniel Adams stated, "that the boundaries of countries, the directions of the principal ranges of mountains, the courses and the outlets of rivers, and generally the situation of towns, etc., are intended to be learnt."[18]

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[18] Daniel Adams, Geography; or a Description of the World (Boston: West and Blake, 1814), p. iii.

Comparisons and classifications were depicted on maps with the use of "emblems" and numerals (Fig. 2). The "new plan" was "designed" to assist the memory by "comparison and classification."[19] For example, the "prevailing Religion, form of Government, degree of Civilization & Population of each country" was depicted on maps with the use of "emblems" or numerals. Thus, the map was developed to give a "complete sketch of the country, with its inhabitants, their institutions, employments, etc."[20]

Map construction exercises generally consisted of sophisticated but simple-to-follow rules for the construction of maps on polar, Mercator, compound (polar and plane) and plane (modified Mercator) projections (Fig. 3). These exercises proceeded from the belief that map drawing exercises had significant educational impact. It was felt that map making left more lasting impressions upon pupil's minds than mere memorization of map content. Incorporating these exercises within geographies was assisted, in large part, by the unfolding contemporary division of geography into three distinct branches -- physical, civil or political, and "mathematical" geography. Mathematical geography dealt with such matters as the place of the earth in the solar system and, more important for our purposes with "the methods of projecting maps and charts."[21] In time, many authors supplemented map construction exercises with rules for drawing maps freehand.

The innovations that we have just mentioned were introduced in an attempt to orient geography scientifically. This is particularly true for the innovation of comparison and classification. As Morse asserted, "geography, as a science, is yet in its infancy . . . we look in vain, in the best treatises on General Geography, for that beautiful order and lucid arrangement, which so much delight us in other sciences."[22] By "lucid arrangement," Morse was referring to the various ways other disciplines classified knowledge. However, after this burst of enthusiasm for the restructuring of geography as a

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[19] William Channing Woodbridge, Rudiments of Geography on a New Plan (1st ed., Hartford: S. G. Goodrich, 1821).

[20] Ibid., p. v.

[21] Joseph Emerson Worcenter, Elements of Geography, Ancient and Modern, with an Atlas (2d ed.; Boston: Cummings and Hilliard, 1822), p. 1.

[22] Jedidiah Morse and Sidney E. Morse, A New System of Geography, Ancient and Modern (Boston: Richardson & Lord, 1822), p. iii.

"science," no significant change occured in the role of maps until 1844 when cerography, a newly-invented map reproduction process, was introduced to American education.

The Third Period: 1844-1890

The development of cerography, a wax engraving method,[23] had a great impact on the nature of geography textbooks. The economy of cerography, together with its compatibility with letterpress printing, eliminated the need for a separate school atlas. Thus, the third period is characterized by the introduction of larger size textbooks which contained ample map coverage. At the outset of the period Sidney Edwards Morse demonstrated the advantage of having maps and map questions either on the same page or on facing pages. The importance of this plan, which fostered the use of quarto editions, was fully realized by many of his contemporaries, who were quick to adopt the new geography textbook size.

Prior to the development of cerography, textual matter and maps could not be printed simultaneously by letterpress (with the exception of wood-cuts). Consequently, different pages were required for maps and text, and, as we have learned, separate bindings were used to hold each of them. However, as early as 1835, Sidney E. Morse, with the assistance of Henry A. Munson, began experimenting with the hope of creating methods of synthesizing the two printing operations. The fruits of their expense and labor ripened four years later with the development of a new printing process which Morse called "cerography" (Fig. 4).

A map of Connecticut, the first example of this new "art" (as Morse himself referred to it) appeared in the New York Observer on June 29, 1839. Because of its quality of having a raised printing surface, the map plate could be positioned with regular type and the two printed simultaneously.

The ramifications of this invention, particularly with regard to geographic pedagogy, cannot be overemphasized. There is no doubt that it profoundly affected the basic format of contemporary geographies. Moreover, owing to the jealously-protected secrets of cerography, it seems to have forced a flurry of research leading to the perfection of printing processes having similar capabilities.

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[23] See Erwin Raisz, General Cartography (New York: McGraw-Hill Book Co., Inc., 1948), pp. 50, 161-62.

In other words, although contemporary geographies were now quarto in size, not all could contain cerographic maps. Many improvements of old map making methods, such as lithography, as well as the results of entirely new developments, such as electrotype maps, rivalled the use of cerography for the remainder of the period. Quality maps subsequently could be reproduced at costs that were lower than ever before.

By 1842, cerography was employed by Morse to produce the Cerographic Atlas of the United States,[24] and to bring about the publication in 1844 of the "best and cheapest school geography extant," A System of Geography, which was sure to "drive everything else from the market in less than two years."[25] The text sold for fifty cents and contained some fifty-one cerographic maps, which were colored not only by the hand method but also by lithography. This was made possible by the "facility" with which the cerographic plate could be prepared for the "press of Lithography."[26]

The resulting impact that this text had on contemporary geographic pedagogy is best understood if we view, in Morse's own terms, the facility with which maps could now be handled. Morse stated that the

> .... Arrangement (of his book) is such that the Map, Questions on the Map, and Description of each country, are on the same page, or on pages directly opposite, enabling the pupil to refer readily from one to the other, without the inconvenience of two books (the text and the atlas), or even the necessity of turning the leaf.[27]

Moreover, a greater number of maps was available at the lowest cost in the history of early American geography.

Beyond adopting a new format for convenient map use, there were

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[24] Samuel Breese and Sidney E. Morse, eds., Cerographic Atlas of the United States (New York Observer Supplement) (New York: Sidney E. Morse and Co., 1842).

[25] Sidney Edwards Morse, A System of Geography for the Use of Schools (New York: Harper & Brothers, 1849), back cover.

[26] Breese and Morse, op. cit., preface.

[27] Sidney Edwards Morse, op. cit., p. iii.

numerous attempts at improving map study by adjusting map content. Initially, maps were cleared of symbols familiar to the second period. Because traditional maps, "professedly intended to elucidate," were

> .... rendered rather labyrinths of perplexity, by being covered with circles, lines, and various names and emblems, mysterious to the pupil, irrelevant to his stage of progress, and by confusing the eye in its search for more radical matters, the source of much vexatious waste of time ....[28]

they were redesigned. Thus, maps were cleared of the clutter of symbols familiar to the second period. Some writers were so intent upon making maps clear of confusing data they went so far as to provide two sets of maps: one for study, containing only the barest of information, and the other for reference, when a more detailed view of an area was needed. However, because of cost factors, by the end of the period the practice of having two sets of maps, one for study and one for reference, was abandoned.

Several writers chose to increase the pupil's understanding of maps by emphasizing the significance of differing map scales. Novel attempts to have maps on "uniform scales" or "proportional scales" were advanced. This was done so that the "learner may, as he passes from one page to another, perceive the relative magnitude of states and countries."[29] For example, since no single scale could apply to all areas of the world to be mapped, because of the relation between the size of the area to the size of the page, multiples of 100 miles to the inch were used for all maps. Simple calculation gave the comparative size of areas, for comparisons were still considered useful. Large scale maps had scales of low multiples of 100, and small scale maps had scales based upon higher multiples of 100.

Other features common to maps included showing standard time across the top of maps. Heights of land[30] and depths of water, were shown in sectional views, at the bottom. Comparative latitudes were

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[28] Sarah S. Cornell, Cornell's Primary Geography (rev. ed.; New York: D. Appleton & Co., 1857), p. v.

[29] George William Fitch, Colton & Fitch's Modern School Geography (New York: J. H. Colton & Co., 1856), p. iii.

[30] In the 1860's Arnold Henry Guyot introduced color tints to textbook maps to express the altitudes of lowlands and plateaus.

shown on the sides. Comparative areas were shown by using a state, such as Kansas, as a standard of measure.

While the content of maps was reworked by several period writers, other imaginative writers adopted the use of special-subject or thematic maps. These maps focused upon particular aspects of the earth's surface such as physical maps, which gave "bird's eye views of the terrain" (Fig. 5); "structure maps," which depicted the positions, connections, and extent of mountain ranges by straight, broken, black lines, varying in width according to mountain height. The wider or "heavier" the lines, the higher the mountains.[31] Other maps depicted vegetation, rainfall, etc. Such maps reflect the influence of contemporary scholars, viz., Alexander Keith Johnston, David Thomas Ansted, August Heinrich Petermann, Charles Lyell, Thomas Milner, Mary Somerville, and Matthew Fontaine Maury.

Some authors even began using interrupted projections. Notable among them was Arnold Guyot, whose gridless map of the world[32] is perhaps one of the earliest examples of an interrupted projection.[33] Russell Hinman made extensive use of a pole-centered star projection devised by Herman Berghaus in 1879 (Fig. 6).

Generally, all popular period geographies had sections devoted to instructions on map drawing. All employed just about the same technique. Conforming to second period beliefs, they used the methods of drawing by eye. However, second-period map construction exercises were greatly modified because there was a feeling on the part of teachers that it both was too time-consuming and required too much skill. Rather than teaching the pupil to draw maps on specific projections, pupils used "construction methods," which were quite unlike projection grids (Fig. 7). For example, under the plan of Francis McNally, which gained considerable acceptance and was incorporated with slight variation in nearly all third period geographies, a single unit of measure sufficed as a guide to construction rather than projection grids. This reduced the skill necessary in drawing "elegant" maps, while saving time. Dimensions were calibrated by using a scale. Supposedly, this scale made accuracy easier to attain because, regardless of a pupil's skill at drawing, he could at least be expected to correctly measure distances.

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[31] See Arnold Henry Guyot, Guyot's Physical Geography (New York: Scribner & Armstrong, 1873).

[32] Ibid.

[33] Richard E. Dahlberg, "Evolution of Interrupted Map Projections," Internationales Jahrbuch für Kartographie, II (1962), p. 46.

Summary

There is little doubt of the determination on the part of early American geography writers to make maps an integral part of their geographies. During the era, as a result of technological advances, there was an increase in map quantity, and improvement in map quality, and a reduction in the costs of map reproduction. As maps became more available, writers increasingly concerned themselves with educational philosophies which would make possible a more sophisticated use of maps. Due to explorations and scientific discoveries, there was an extension of map content, and, eventually, there was an emergence of thematic maps. Thus, it is clear that maps changed with the times in response to a complex interplay of factors and that a review of these maps gives us a clearer view of geographic instruction during the study era.

Figure Sources

Fig. 1.--Monteith's Object Lessons. ("Object Lessons" presumably helped pupils to comprehend abstraction by relating them to recognizable objects.) James Monteith, Monteith's Manual of Geography (New York: A.S. Barnes & Company, 1873), p. 119.

Fig. 2.--Woodbridge's Chart of the Inhabited World. W. C. Woodbridge and Emma Willard, School Atlas to Accompany Woodbridge's Rudiments of Geography (4th Ed.; Hartford: Oliver D. Cooke & Sons, n. d.).

Fig. 3.--Worcester's Construction of Maps. Joseph Emerson Worcester, Elements of Geography, Ancient and Modern, with an Atlas (2d ed.; Boston: Cummings and Hillard, 1822), Pl. II, opp. p. 321.

Fig. 4.--Morse's Cerographic Map of Ohio and Indiana. Sidney Edwards Morse, A System of Geography for the Use of Schools (New York: Harper & Brothers, 1849), p. 33.

Fig. 5.--Monteith's Relief Map. James Monteith, Monteith's Comprehensive Geography (New York: A. S. Barnes & Company, 1873), p. 35.

Fig. 6.--Hinman's Use of a Star Projection. Russell Hinman, Eclectic Physical Geography (Cincinnati: Von Antwerp, Bragg & Co., 1888), pp. 152-53.

Fig. 7.--McNally's Map Drawing. Francis McNally, An Improved System of Geography (rev. & enlarged ed.; New York: A. S. Barnes & Burr, 1864).

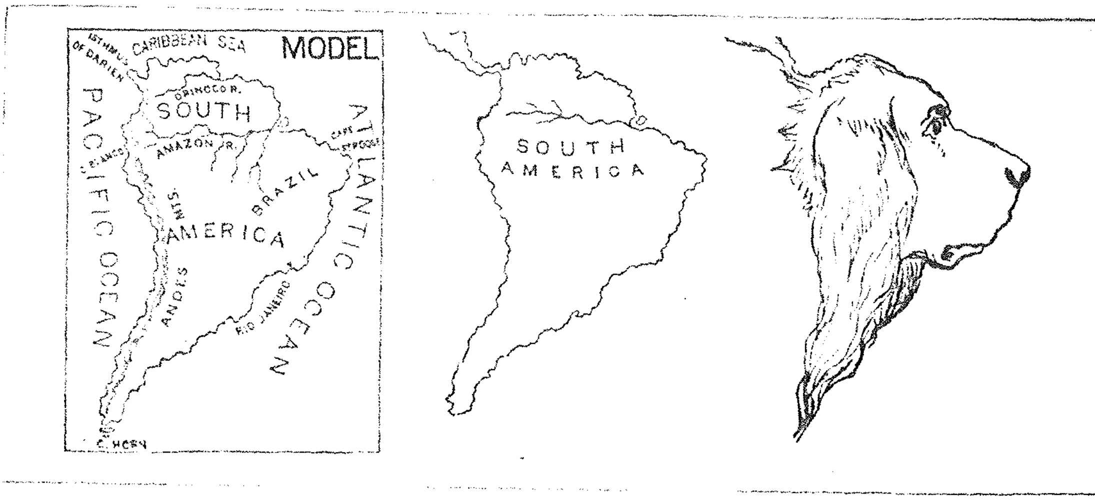
MODEL
CARIBBEAN SEA
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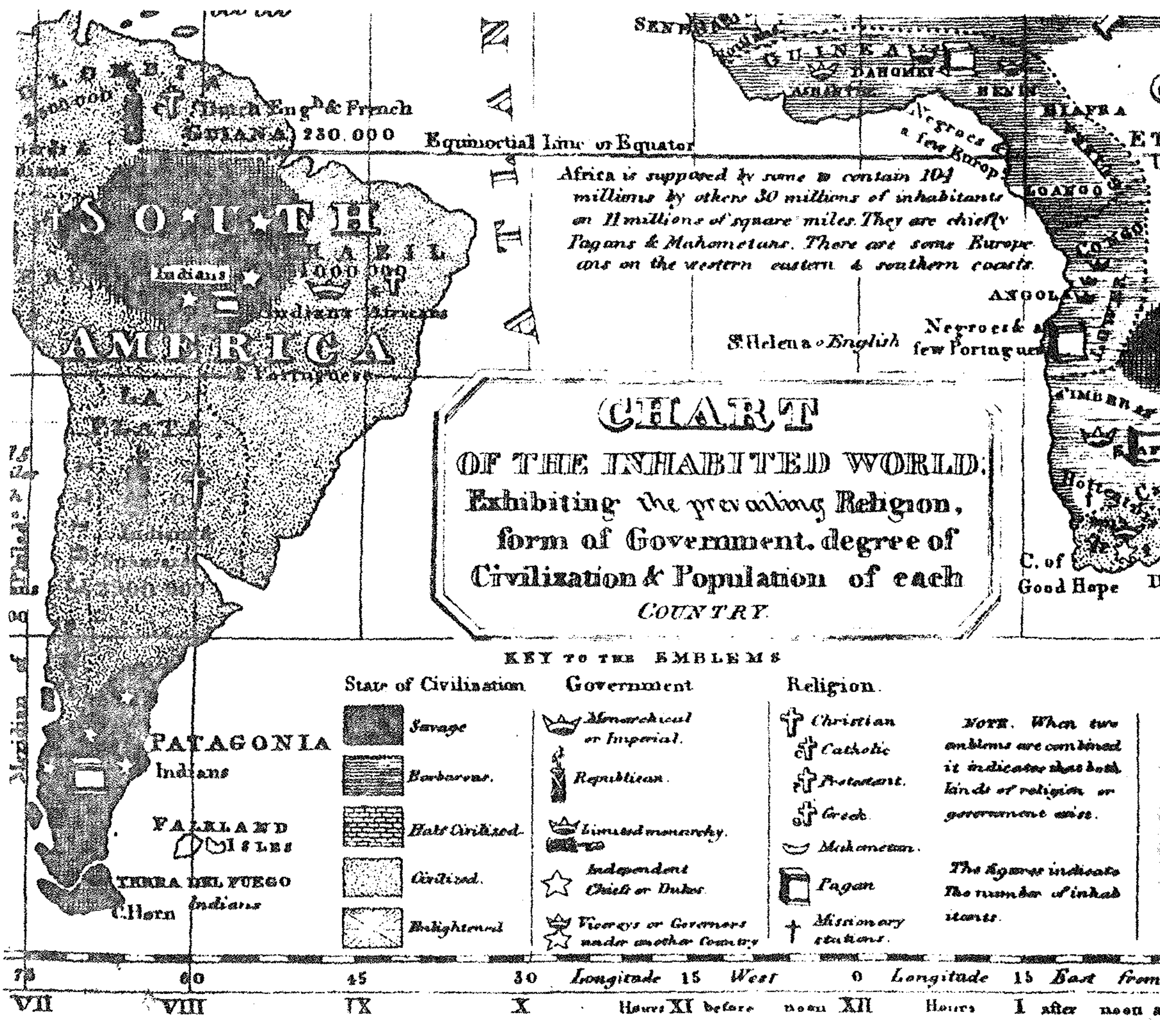
Fig. 1


Dutch Engd & French
GUIANA 230,000
Equinoctial Line or Equator
SOUTH
BRAZIL
Indians
AMERICA
Portuguese
Africa is supposed by some to contain 104 millions by others 30 millions of inhabitants on 11 millions of square miles. They are chiefly Pagans & Mahometans. There are some Europeans on the western eastern & southern coasts.
GUINEA
DAHOMEY
BENIN
BIAFRA
LOANGO
CONGO
ANGOLA
Negroes & a few Europ
Negroes & a few Portuguese
St. Helena English
C. of Good Hope
CHART
OF THE INHABITED WORLD;
Exhibiting the prevailing Religion,
form of Government, degree of
Civilization & Population of each
COUNTRY.
KEY TO THE EMBLEMS
State of Civilization
Savage
Barbarous.
Half Civilized.
Civilized.
Enlightened
Government
Monarchical or Imperial.
Republican.
Limited monarchy.
Independent Chiefs or Dukes
Viceroys or Governors under another Country
Religion.
Christian
Catholic
Protestant.
Greek.
Mahometan.
Pagan
Missionary stations.
NOTE. When two emblems are combined it indicates that both kinds of religion or government exist.
The figures indicate the number of inhabitants.
PATAGONIA
Indians
FALKLAND ISLES
TERRA DEL FUEGO
Indians
C. Horn
75
60
45
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Longitude 15 West
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Longitude 15 East from
VII
VIII
IX
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Hours I after noon

Fig. 2

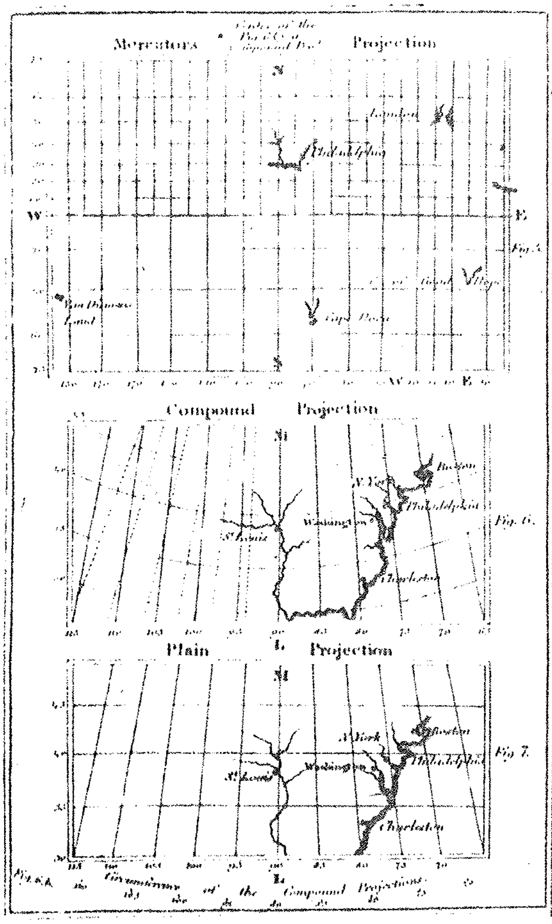


Fig. 3

Fig. 5

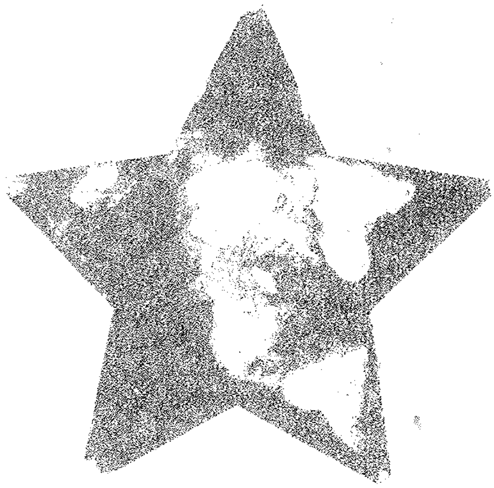


Fig. 6

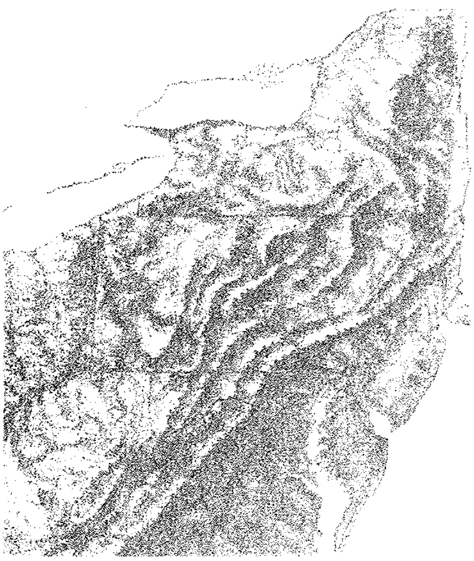


Fig. 4

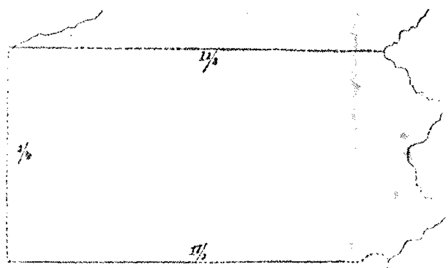
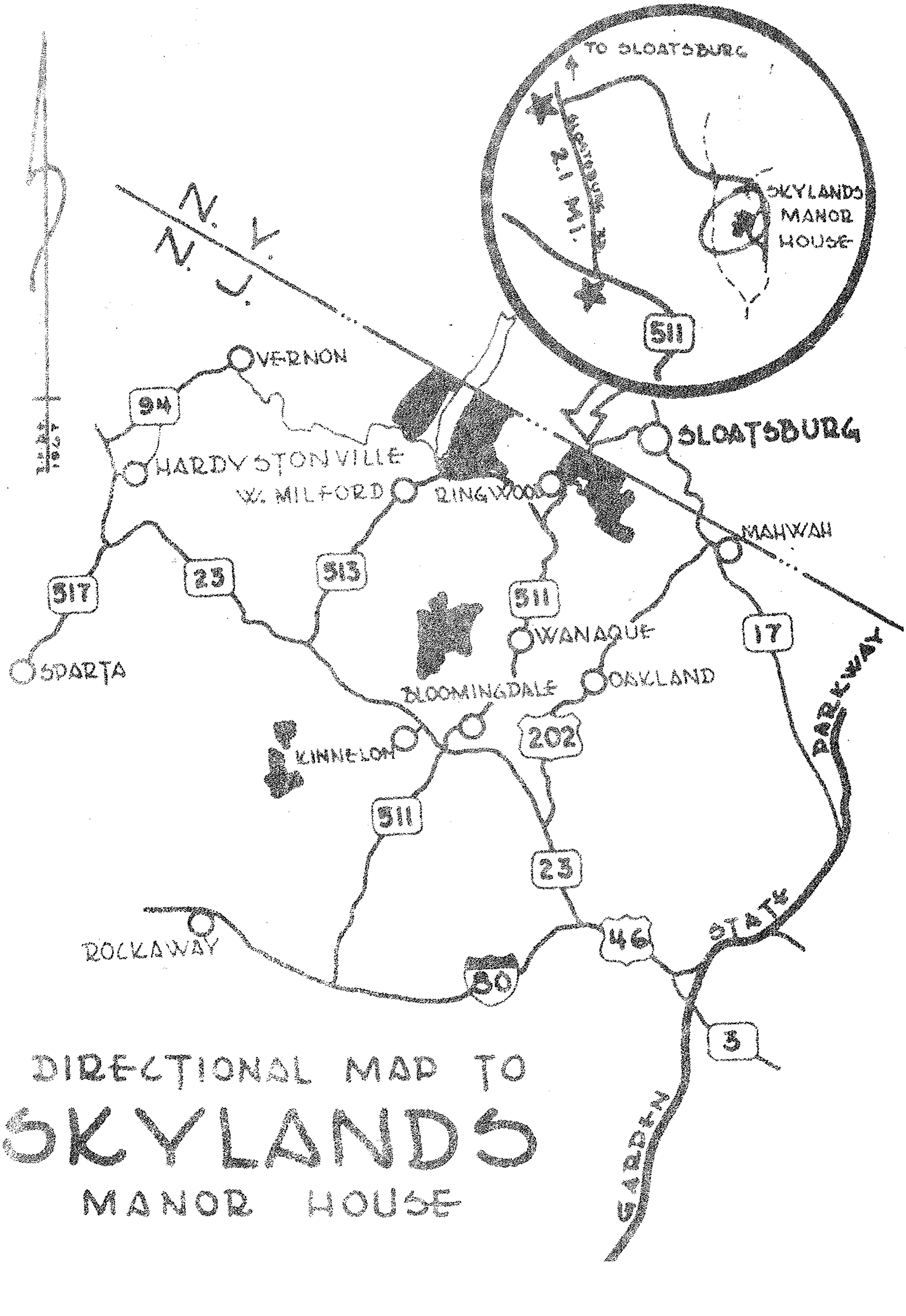


Fig. 7


TO SLOATSBURG
2.1 MI.
SKYLANDS MANOR HOUSE
511
N.Y.
N.J.
VERNON
94
HARDYSTONVILLE
W. MILFORD
RINGWOOD
SLOATSBURG
MAHWAH
517
23
513
511
SPARTA
WANAQUE
OAKLAND
BLOOMINGDALE
17
KINNELON
202
PARKWAY
511
23
ROCKAWAY
46
STATE
80
3
GARDEN
DIRECTIONAL MAP TO
SKYLANDS
MANOR HOUSE

TECHNOLOGY AND LOCATION IN THE EARLY AMERICAN IRON INDUSTRY:

AN EXAMPLE FROM RINGWOOD MANOR, NEW JERSEY

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State University College at Buffalo

The technological advancements of the late eighteenth and early nineteenth centuries profoundly altered the locative factors relative to America's iron industry. Early manufactories, distributed along the eastern seaboard from Massachusetts to North Carolina, utilized techniques borrowed from the ironmasters of Europe. By the end of the nineteenth century, the skills of modern iron making had been perfected and widely disseminated. Ringwood Manor, one of several ironworks located in the New York-New Jersey Highlands, illustrates the impact of technological change upon the morphology and function of an early American iron community.

Situated within the meager valley of Ringwood Creek, a tributary of the Wanaque River, Ringwood Manor occupied a portion of Ramapo Mountain adjacent to the New York-New Jersey boundary (Fig. K1). The broad, well-dissected uplands furnished all vital natural resources needed for development of a successful eighteenth-century charcoal ironworks -- plentiful running water, verdant forests, abundant iron ore, and nearby sources of limestone.

Initial attempts to establish an iron industry in northeastern New Jersey during the early decades of the eighteenth century met with failure for want of a substantial local demand for iron and the absence of a reliable means of transporting iron products to markets, chiefly New York. In response to a 1764 newspaper advertisement offering the Ringwood property for sale,[1] Peter Hasenclever, agent for

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[1] The New York Mercury, March 5, 1764, quoted in William Nelson, ed., Archives of the State of New Jersey: Documents Relating to the Colonial, Revolutionary, and Post Revolutionary History of the State of New Jersey, First Series, XXIV, 328-329. (This series will hanceforth be cited as New Jersey Archives.)

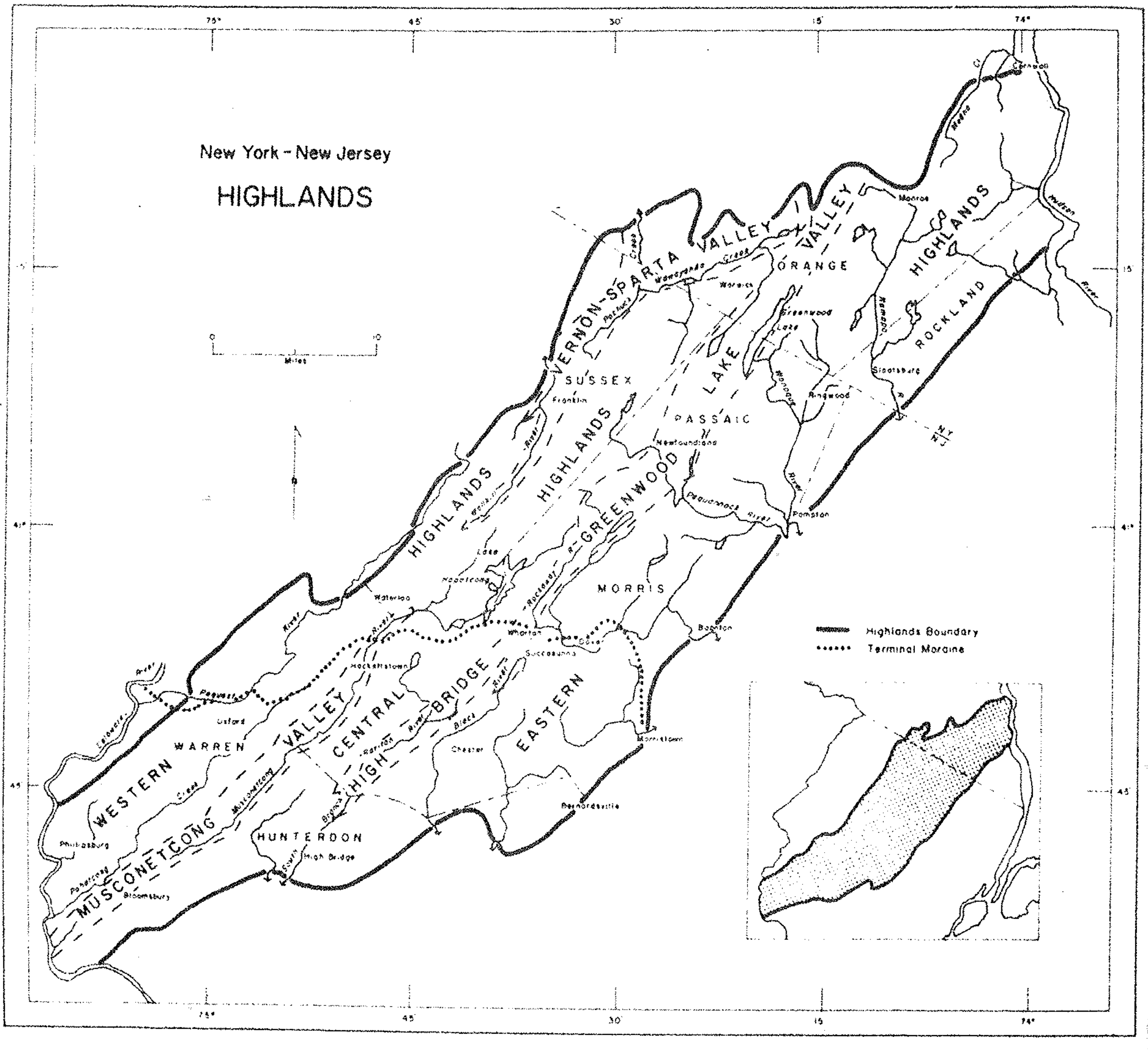

Fig. K1--Locational Map

the London-based American Company, purchased the lands with the sole intention of developing an iron community. Impetus for such a venture was provided by a newly opened duty-free English market, the needs of a growing local population, the demands for iron in the southern colonies, and later, the Revolutionary War.

Hasenclever's plantation consisted of industrial, agricultural, and financial units dispersed over approximately 10,000 acres. Several forges, mills, and iron mines were clustered about a blast furnace which formed the nucleus of the manor (Fig. K2). Good stands of timber were protected for use in making charcoal and as a source of building materials. Valleys were cleared and cultivated by farmers and their grain was ground at the community gristmill. Natural meadows and wetlands were taken up for hay and pasturage. A manor house, workmen's cottages, barns, stores, storage facilities, and a sawmill completed the scene. Men of many skills were encouraged to settle nearby ". . . on Account (of) the great Numer (sic) of People employ'd at the Iron Works . . . there is generally as good a Market for Grain, and other produce as at New York."[2] In exchange, the manufactories furnished utensils, chimney backs, nails, and sundry other products.

The central feature of the plantation was the blast furnace (Fig. K3).* An eighteenth-century furnace was a four-sided stack of native stone, some twenty to thirty feet high and having a base of twenty to twenty-five feet tapering toward a top of two-thirds the base dimensions. The interior core, or bosh, varied from three to ten feet. Such a furnace was capable of producing an average of twenty-five tons of pig iron per week while in blast. In addition, the furnace was built convenient to a rise of land from which bushels of iron ore, charcoal, and limestone were carted over a log or plank bridge to a charging hole at the top.

Large tracts of well-timbered land were set aside to supply the charcoal consumed by the furnace. Clear-cutting of the forests furnished both conifers and broadleaf deciduous trees for the collier's pits, although sprout hardwoods were preferred for the consistent quality of charcoal produced. The bulkiness of the finished product and its transport over difficult terrain limited timber exploitation to those woodlots within two and one-half miles of the furnace.

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[2] The New York Gazette, March 7, 1763, quoted in William Nelson, ed., New Jersey Archives, First Series, XXIV, 145.

* The author is indebted to Mr. Karl Drescher for the pen-and-ink illustrations.

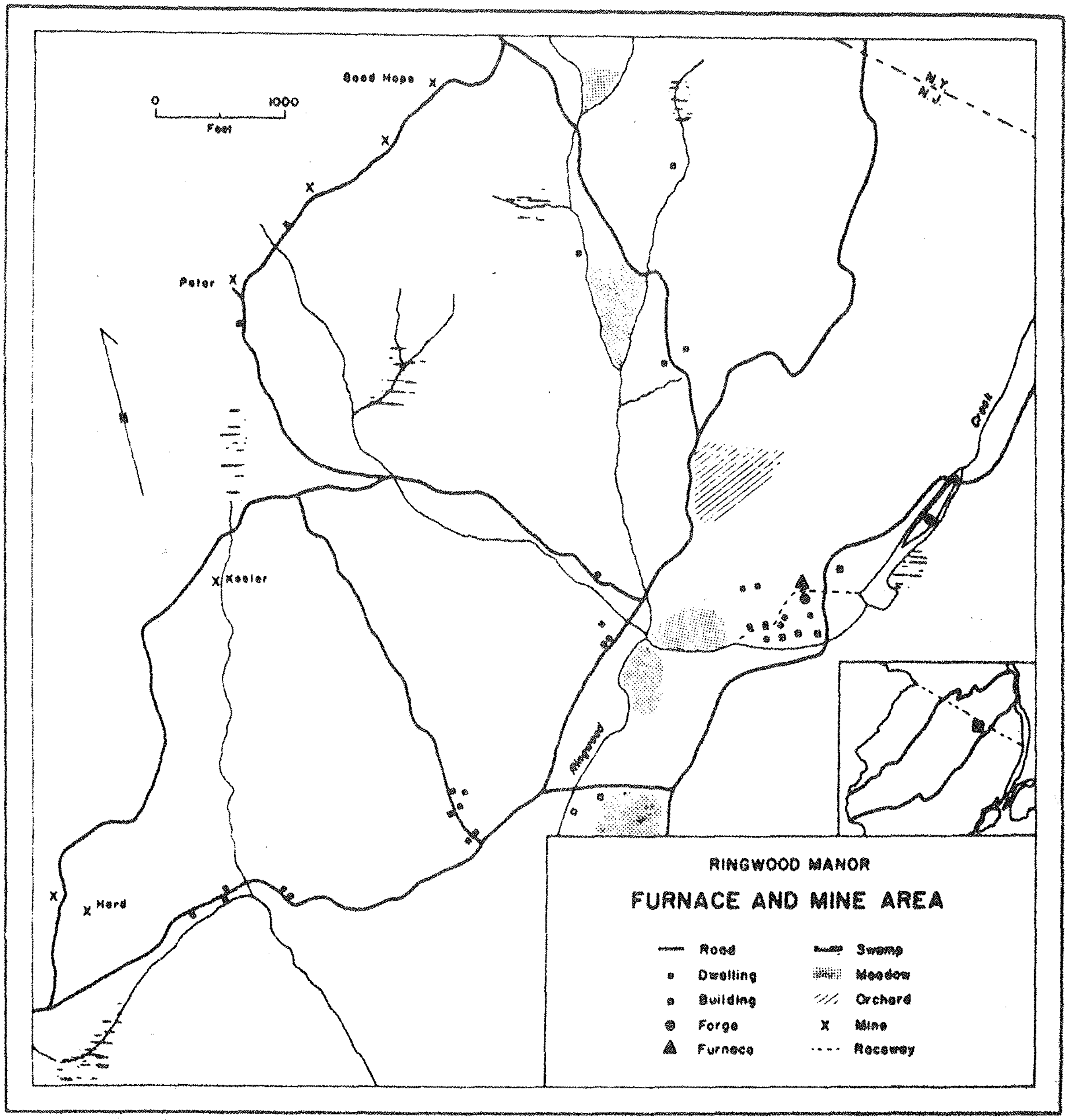
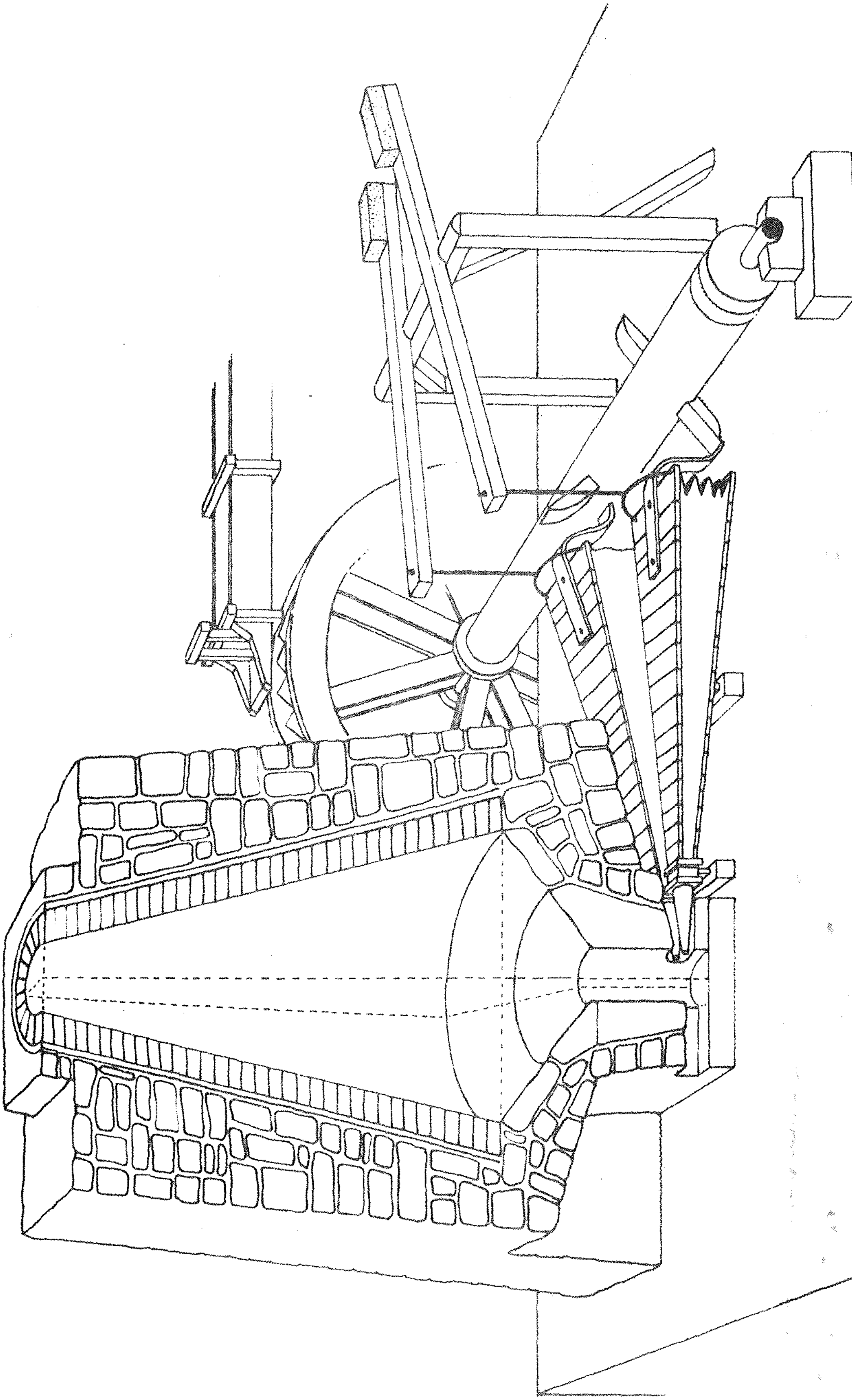

Good Hope
0
1000
Feet
N.Y.
N.J.
Peter
N
Keeler
Creek
Ringwood
Hard
RINGWOOD MANOR
FURNACE AND MINE AREA
Road
Dwelling
Building
Forge
Furnace
Swamp
Meadow
Orchard
Mine
Raceway

Fig. K2



Several large ore bodies were found on plantation lands, and by 1775, at least eight pit mines were operative, yielding ores of sixty to seventy percent iron. Additional openings had been abandoned because they ". . . abounded in sulphur or copper, or had qualities which rendered the goodness of the ore dubious."[3]

The final locative factor -- water -- was needed to turn the waterwheels which furnished power for the bellows-operated furnace. A dam, constructed across Ringwood Creek, ponded and diverted water into a raceway leading to the furnace area. Dependence upon water as the energy source proved to be a nuisance at several times in the year. Winter ice choked the waterwheels, frequently halting activities for long periods; spring floods damaged some equipment every year; and summer drought drastically reduced the supply of water just when demand was at its peak.

The molten iron which issued from the furnace was cast into a variety of articles or molded into the more familiar "sow and piglet" form. The latter was then carried to one of four forges erected on Ringwood Creek.

Here, in finery and chafery fires, pigs of iron were refined by successive heatings and hammerings and prepared for sale as rolled, slitted, or bar iron (Fig. K4). The conversion of pigs into refined metal generally resulted in a weight loss of thirty percent, which was coupled with a fifty percent increase in the amount of charcoal per ton of iron and a greater use of labor. In order to offset the additional manufacturing costs with lower distribution expenses, forge operators often chose riverine sites near either market or transport, not near the furnace.

Analysis of the Ringwood record book from 1774 to 1778,[4] indicates that sale prices of Ringwood iron products compared favorably with the situation elsewhere in the colonies. Total cost of the raw materials, transportation, labor, and incidental expenses amounted to £6 or £7 per ton (the approximate value of the pound was $4.45). A ton of pig iron brought £8.7s at the market.

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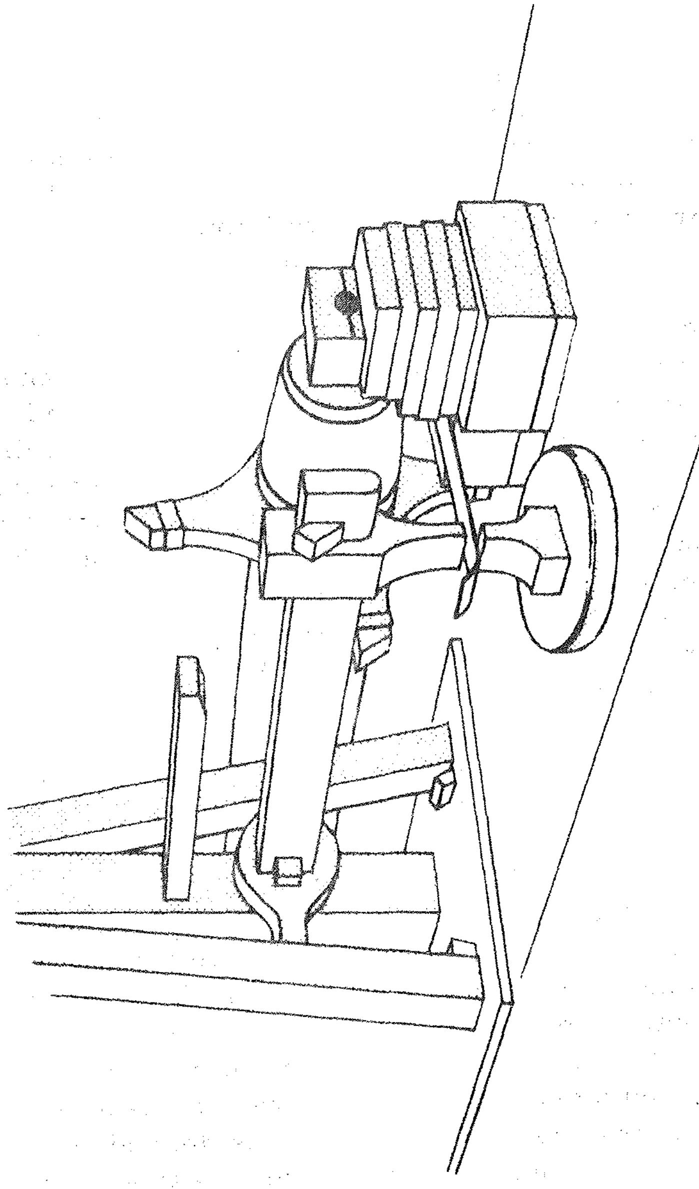
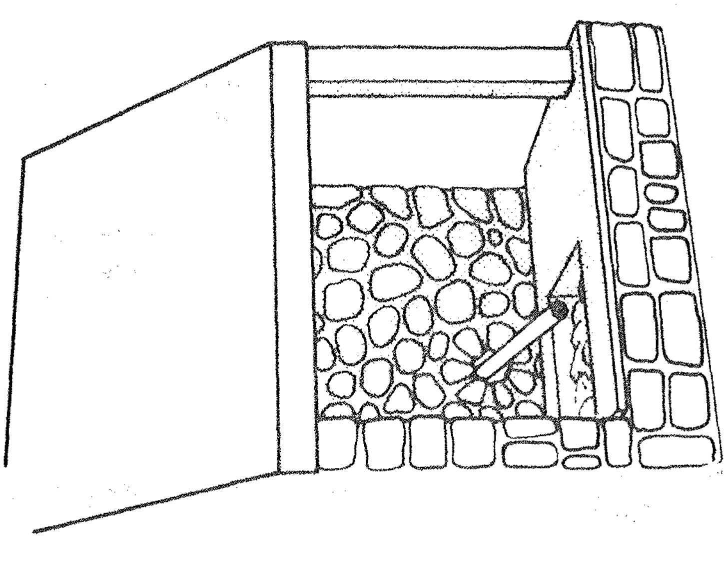
[3] The New York Gazette; and the Weekly Mercury, September 21, 1772, quoted in William Nelson, ed., New Jersey Archives, First Series, XXVIII, 249-250.

[4] Robert Erskine Record Book, 1774-1778, MSS, New Jersey Historical Society.





The aforementioned weight loss in the conversion of pigs into bars, increased charcoal consumption and labor usage, and substantially higher transportation charges -- from furnace to finery, finery to chafery, and chafery to market -- was reflected in a market price of £28 to £30 per ton of bar iron. In 1776, the last full year of production prior to the Revolutionary War, almost 400 tons of Ringwood bar iron were sold on the New York market.

The four decades following the war saw distinct changes take place in the American iron industry. Ringwood and other colonial iron centers suffered severe economic duress and underwent a period of general decline. Independence had resulted in the loss of America's major foreign iron market. Moreover, the fledgling nation had neglected to impose adequate duties on foreign iron, bringing a deluge of cheap, superior products from a resurgent English industry. As iron prices declined in the face of stiff competition, domestic manufacturing costs increased. Charcoal became scarce in many areas as farmers brought more land under cultivation. Ironworkers, no longer subject to indenture, demanded higher wages or sought other employment. Finally, a transportation system based on oxcarts and horse-drawn wagons traveling over ungraded, stump-filled roads was incapable of providing a cheap means of conveying iron products to market.

A complete collapse of the iron industry would have been inevitable had not steps been taken to alleviate the above conditions. Intensive turnpike building and construction of the Morris Canal, opening a water route from the Highlands to the Hudson and Delaware rivers, were examples of the attempts made to remedy the transport problem (Fig. K5). Introduction of anthracite coal as a smelting agent in the 1830's freed the iron industry from its dependence on charcoal. And, adaptation of the steam engine to iron making increased furnace efficiency and productivity.

A substantial realignment of the locative factors governing iron manufacture followed, for as Ashton has stated:

> Now that the whole process could be carried on with cheap mineral fuel there was no longer any reason for that separation of furnace, forge, and mill that had characterized the iron industry in the early years. . . .[5]

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[5] T. S. Ashton, Iron and Steel in the Industrial Revolution (New York: Augustus M. Kelley, 1924), p. 100.

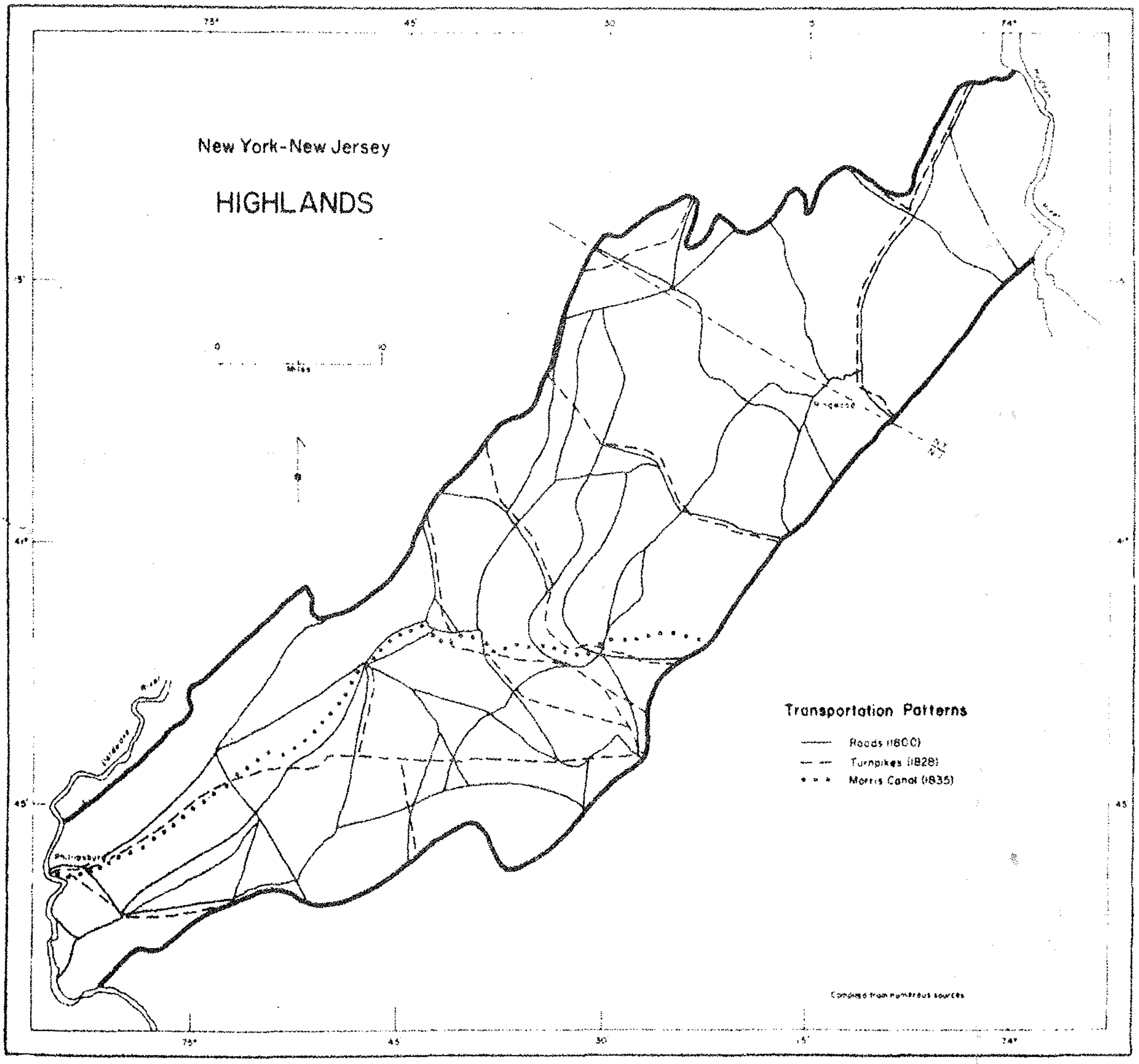
New York-New Jersey
HIGHLANDS
Transportation Patterns
Roads (1800)
Turnpikes (1828)
Morris Canal (1835)
Phillipsburg
Compiled from numerous sources

Fig. K5

The Morris Canal not only united Pennsylvania anthracite and Highlands manufactories, but also opened new markets for the latter region's iron ore. After all, it made better sense to haul two tons of iron ore to newly established ironworks in eastern Pennsylvania than to carry five to seven tons of coal to Highlands furnaces (referring to the tonnage necessary for one ton of pig iron). The supremacy of the coal site as the primary locative factor in the nineteenth-century iron industry had been established.

By 1850, better transportation and technological achievements had combined to lower substantially the cost of iron making. French calculated the actual cost of pig iron manufactured with charcoal to be $25 to $28 per ton, while the cost of making it with anthracite was $15 to $17 per ton.[6] Thus, anthracite iron was sold for less than the cost of charcoal iron and compared favorably with the price of iron imported from England. A boom in Highlands iron mining became closely tied to the growth of anthracite iron manufactories in the Delaware and Lehigh valleys.

Severance of all connections with the American Company during the Revolutionary War and the technological changes which followed greatly affected operations at Ringwood. As with other ironworks, attempts to revive the manor in the early decades of the nineteenth century proved fruitless. The lands were finally sold to the Trenton Iron Company which intended to utilize the considerable iron ore deposits in furnaces and mills at Trenton and Phillipsburg, New Jersey. As had been envisioned by the advent of the Morris Canal, the transition from manufacturing iron products in the Highlands to supplying iron ore became a reality.

A large-scale rejuvenation of the Ringwood property was undertaken (Fig. K6). The all-important mine shafts were drained and refurbished. Lying at a distance from the mine area, much of the old manor complex was abandoned and later dismantled. Only a few forge fires were maintained for the manufacture of iron plate and wrought iron. A company town of clapboarded multistory or multifamily dwellings, general stores, a church, and a tavern was erected near the mines, evoking memories of the defunct plantation era.

The full potential of Ringwood as a mining center went unrealized due to a chronic lack of adequate transportation from mine to market. The entire Ramapo region, being a rather remote and

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[6] B. F. French, History of the Rise and Progress of the Iron Trade of the United States from 1621-1857 (New York: Wiley and Halstead, 1858), p. 150.

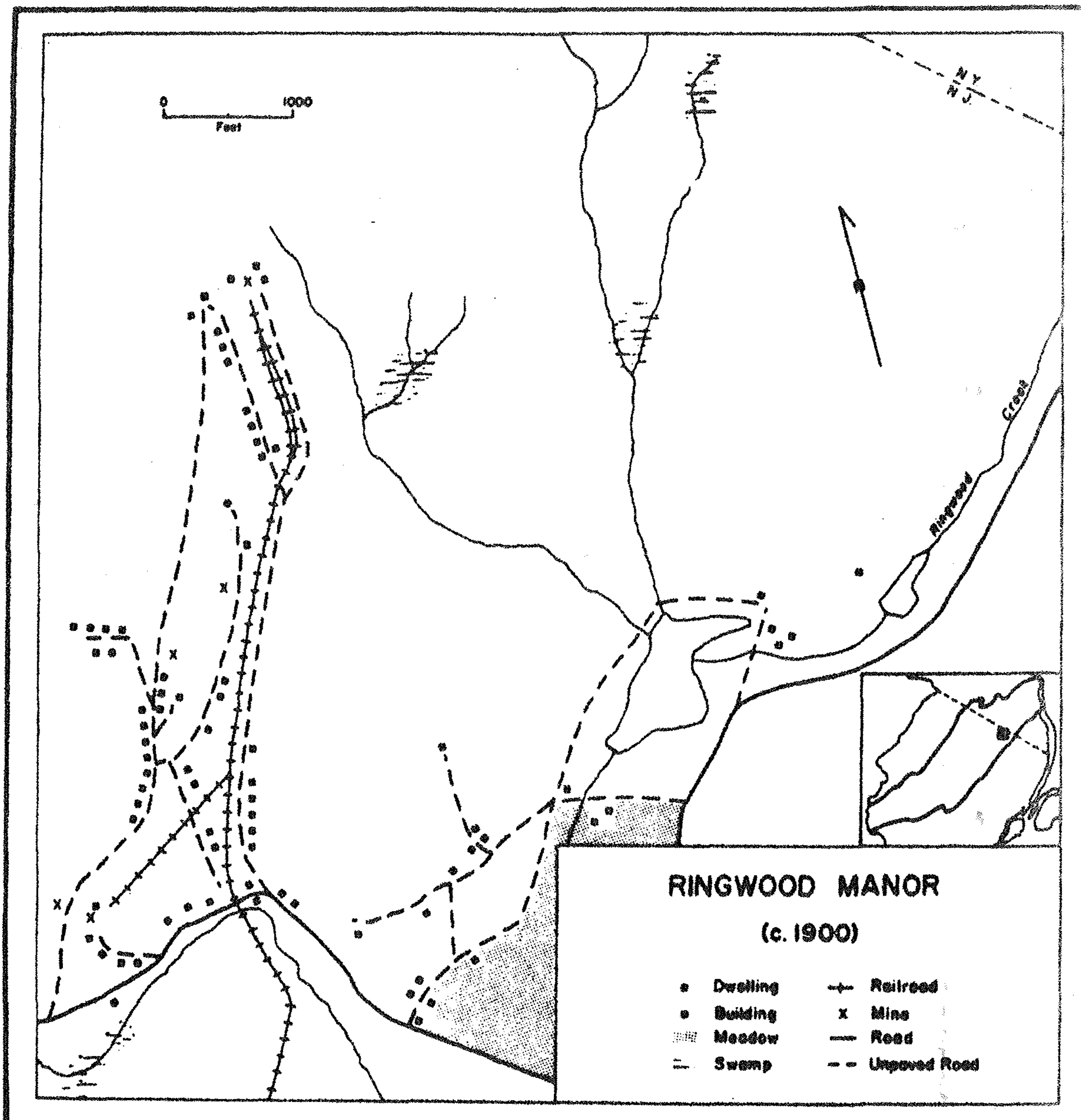
0
1000
Feet
N.Y.
N.J.
Ringwood
Creek
RINGWOOD MANOR
(c. 1900)
Dwelling
Building
Meadow
Swamp
Railroad
Mine
Road
Unpaved Road

Fig. K6

sparsely populated sector, had been ignored by the builders of turnpikes and the Morris Canal. Consequently, Ringwood iron shipments still used eighteenth-century roads and horse- or ox-drawn wagons.

To forestall complete abandonment of the renovated mines, it was proposed that a railroad be built over favorable terrain within the Wanaque Valley. Ringwood iron ore could then be sent to the Morris Canal at Pompton for transport to the Delaware River. However, the plan was discarded when the Morris Canal and Banking Company refused to grant sizable toll reductions on ore shipments emanating from Ringwood. When an alternate recommendation to erect blast furnaces in close proximity to the iron mines and convey finished products to seaboard markets proved economically unsound - for want of good transportation - the ultimate demise of activity at Ringwood became apparent.

By the time a railroad finally arrived at Ringwood in the late 1880's, further technological changes had once more altered supply patterns within the American iron industry. Widespread use of the Bessemer process and coke -- a by-product of bituminous coal -- rendered previous iron-making techniques obsolete and lowered the cost of pig iron to $12 or $13 per ton. This figure could not be matched by either charcoal or anthracite technology. Furthermore, most Highlands iron ores assayed rich in phosphorus and proved unsuited to the needs of a new era. The Ringwood mines were shut down. Only the Peter and Cannon mines were to be reopened periodically in the twentieth century.

The center of the American iron industry shifted westward, lured by a new technology and the twin discoveries of bituminous coal in western Pennsylvania and hematite ore in the ranges around Lake Superior. The decline of Ringwood and other seaboard centers coincided with the rise of Pittsburgh, Cleveland, and Buffalo. In terms of distance, geographic relocation from the eastern seaboard to the Great Lakes was slight; however, it was great when viewed as heralding the cessation of the iron industry in the New York-New Jersey Highlands.

GEONOMY -

A NAME PROPOSED FOR THE FIELD OF GEOGRAPHY

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The primary purpose of words is to communicate ideas. In recent years the word geography has fallen farther and farther short of the mark. During the same period of time the need to communicate ideas ever more precisely has grown at an exponential rate. Various solutions for this problem have been suggested, but none seems to have achieved any significant success. Numerous books and articles have been written telling what geography is and what geographers do; but, as it turns out, it is one thing to tell what geographers do (i.e., identify the field of geography) and quite another to acceptably tell what geography is (i.e., define the word).[1] The purpose of this paper is to suggest a different type of solution - one which identifies and gives a new name to the field of geography and defines the word as a lesser part of that field.

Webster's New International Dictionary defines geography as follows:

> "ge-og'ra-phy...(fr.Gr....gē, the earth + graphē description....) 1. The science of the earth and its life; esp., the description of land, sea, air and the distribution of plant and animal life, including man and his industries, with reference to the mutual relation of these diverse elements. 2. A treatise on this science; also a geographic description... 3. The natural features, collectively, of an area; as the geography of Haiti."[2]

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[1] Wendell J. Brown, "A Lawyer Looks at the Name Geography," The Professional Geographer, Vol. XIII, No. 3, May 1961, pp. 16-19.

[2] Webster's New International Dictionary of the English Language, G&C Merriam Company, Springfield, Mass., 1955, p 1048.

As a word, geography consists of two parts: geo- meaning earth and -graphy meaning description. Both parts create difficulties. Since geo- is unlimited in systematic scope, it has allowed proliferation of the word into any field of study pertaining to the earth and, as a result, has created a rather controversial relationship between geography and such major subjects as geology, biology and sociology. On the other hand, -graphy is too limiting. Over the years, the field of geography has dramatically grown to include a very important scientific aspect. Yet nongeographers continue to balk at geography being anything more than mere description. And in this they are not being unreasonable. Description is either stated or implied in each of the three alternative definitions given above. In addition, the use of the word science in the first alternative seems to be erroneous. To the nongeographer the sciences of the earth and its life are geology and biology and these are not considered lesser fields of geography. Whether we geographers like it or not, the communication value of the word geography is good only for denoting earth description. Beyond this its use is liable to confuse more than clarify.

Some of us get around this problem by defining and identifying with a particular kind of geography (e.g., economic geography, quantitative geography, urban geography, cultural geography, etc.). This reduces the possible confusion caused by the unmodified word, but it only evades the main issue. There are others of us who propose new definitions of geography; but, since the primary fault lies in the word itself, these efforts appear to be self-defeating. A more realistic solution seems to be to rename the field of geography and restrict the use of the word geography to the portion of that field which emphasizes earth description. In taking such an approach, the word geography becomes self-defining. There remains, however, the problem of determining the limits to and finding a suitable name for the field.

There are two ways of determining the limits of a field of study. One is to subjectively add its various parts until the limits of the whole are attained. The inherent difficulty here is knowing all the parts that belong. The second method is to start with the whole of knowledge and objectively substract all parts that do not belong until the limits of the remainder are attained. In this method the inherent difficulty is in leaving too many parts in the remainder. Nevertheless, in the solution of the present problem, it is this second method which furnishes the most fruitful approach.

Philosophers generally divide knowledge into the five areas shown in Figure 1. Although, as geographers, we have an interest in them all, we are primarily concerned with a portion of metaphysics which is the study of the metaphysical universe or, more simply, the meta-universe. Division of this meta-universe into its two basic elements is shown in Figure 2. And it is in Figure 2 that we encounter the first of the three major dichotomies which presently plague the meaning of geography - the physical versus the psychical nature of its subject matter. The meta-universe has two coexistent elements: The natural or real universe which can be physically perceived through the senses or with instruments, and the supernatural or ideal (i. e., of ideas) universe which exists only in the mind or psyche (hence the adjective psychical). By his nature, man exists in and is increasingly aware of an ever expanding portion of both.

Once philosophers have divided the meta-universe into its two elements, their definitive interest generally stops. Further divisions are left to the subjectively oriented people like ourselves working from the opposite direction. Unfortunately, this leaves a rather awkward gap. To continue the present course of analysis requires the crossing of this gap and this can only be done by constructing a bridge of new terminology.

In constructing such a bridge, there are several mandatory requirements. Its terminology must be logical and flexible. Each of the terms, at the very least, must have a root identifying the subject of interest and a suffix indicating the manner of approaching the subject. There must be provision for the use of modifying prefixes and adjectives. Each term must have a specific place in a hierarchy of terms which ultimately encompasses the entire meta-universe. Finally, the terms should match as closely as possible the corresponding terms in current usage. Figures 3, 4 and 5 contain the framework of a terminology meeting these requirements.

Figure 3 shows the two root hierarchies and also illustrates the second major dichotomy plaguing geography - regional (or spatial) units versus topical (or systematic) units of study. Column 1 divides the meta-universe into topical units, the major divisions of which are either physical or psychical. Column 2 physically divides the meta-universe into ever smaller spatial units, which breakdown can be extended, if desired, to the atom and below. Since thinking creatures must be associated with a spatial unit, these units also serve as spatial divisions for psychical topics. Thus, in addition to containing the regional versus the topical dichotomy, Columns 1 and 2 also contain the dichotomy between the

Division	Subject of Study
Logic	Standards of valid thinking
Epistemology	Knowledge itself
Aesthetics	Sensual knowledge
Ethics	Standards of conduct
Metaphysics	The natural and supernatural universe

Figure 1 -- The Divisions of Knowledge. (Simplified from information contained in The Dictionary of Philosophy, ed. Dagobert D. Runes, Littlefield, Adams & Company, Patterson, N.J., 1966.)

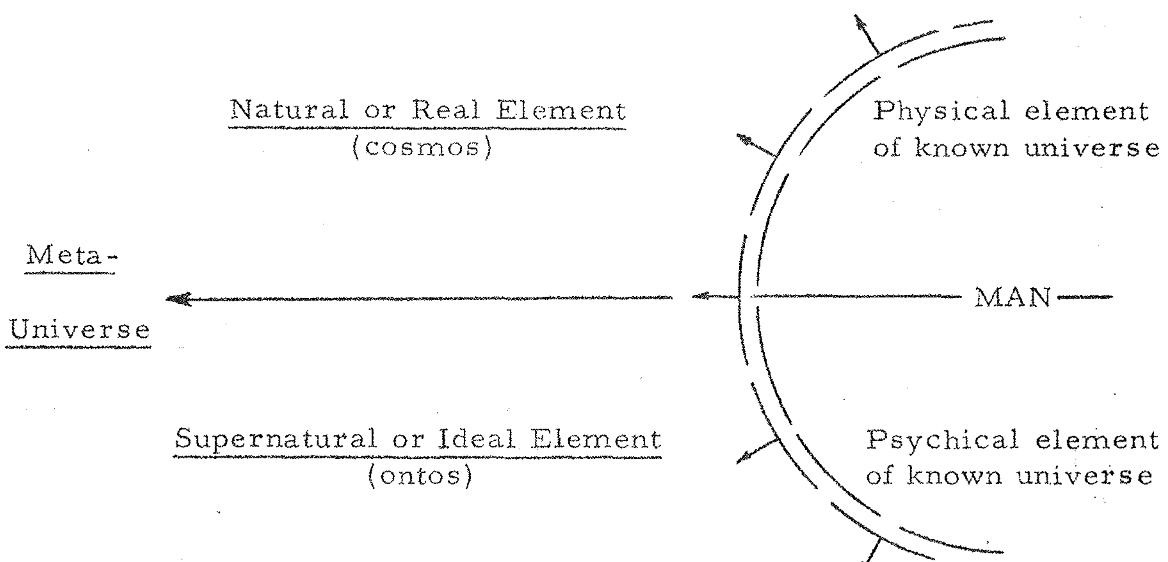


Figure 2 -- Elements of the Meta-Universe.

<u>TOPICAL ROOT</u>	<u>REGIONAL ROOT*</u>
Physio-	Meto-
Bio-	Cosmo-
Climato-	Galacto-
Hydro-	Astro-
Litho-	Planeto-
Minero-	Geo-
Pedo-	Africo-
Meteoro-	Europo-
<u>Morpho-</u>	Luno- (Seleno-)
↓ etc	<u>Martio-</u>
	↓ etc
Psycho-	
Socio-	
Econo-	
<u>Polito-</u>	
↓ etc	

* May be used as prefixes for topical roots

Figure 3 -- Framework of the Root Hierarchy.

<u>-nomy</u>	<u>-logy</u>		Scientific Aspect
	<u>-gony</u>	<u>-history</u> (temporal narrative)	Descriptive Aspect
		<u>-graphy</u> (spatial narrative)	

Figure 4 -- The Suffix Hierarchy.

physical and psychical elements of the meta-universe which was mentioned earlier.

As a further comment on the mechanics of this new terminology it should be noted that the use of a regional root implies that all applicable physical and psychical topics are considered for that particular region. On the other hand, the use of a topical root implies universal consideration of the topic. Should universal applicability be impractical or create confusion, the appropriate region of Column 2 can be used as a restrictive prefix. Examples of this will be shown later.

Figure 4 shows the hierarchy of suffixes which indicates the approach to each subject. Three of these are basic suffixes. The first, -logy, indicates a scientific or analytical approach, while -history and -graphy indicate a descriptive approach in time and in space respectively. And here is the third major dichotomy plaguing geography - that of the scientific (or analytic) versus the descriptive (or synthetic) approach. It should be noted, however, that the suffix used merely indicates the approach receiving the greatest emphasis and does not exclude consideration of others. The suffixes -gony and -nomy are combinatives which complete a logical structure. The former includes both descriptive approaches while the latter includes all approaches.

Finally, the proposed terminology includes a temporal hierarchy which is used as a source of adjectives to modify regional divisions. Since each region has its own rather distinctive time divisions, each has its own temporal hierarchy. An example of one for earth is shown in Figure 5.

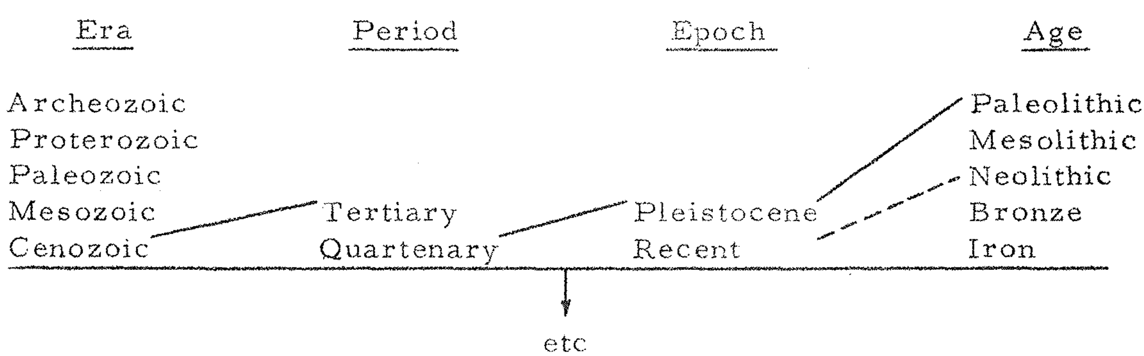


Figure 5 -- Hierarchy of Temporal Adjectives for the Earth.

Having constructed this new terminology, the next step is to examine how the various terms fit together. Figure 6 furnishes an example. In this diagram geonomy represents the total study of the earth. It is a subdivision of planetonomy which is the general study of all planets. This, in turn, is a subdivision of astronomy which is a subdivision of galactonomy, etc. In examining Figure 6, it should be apparent that some of the new terms are either entirely new or are identical in form and meaning to terms in current use and, as such, create no conflicts. But there are some cases (as in the conflict between astrology and astrophysics) where the new terminology requires that an old word be given a new usage or where an old usage is identified with a new word. Such conflicts are obviously undesirable, but they represent the lesser of two evils. The other alternative is to subjectively avoid such conflicts; and it has been the adoption of this "easier" alternative that through the years has allowed the development of the very awkward terminological situation which today exists in many fields - but especially in the field of geography. This is best illustrated by analysing the subject matter of the term geonomy which at the same time allows us to refocus on the problem of identifying the field of geography.

Figure 7 shows some of the topical divisions of geonomy. Structurally, it is self-explanatory, but there are many hidden implications. Starting in the upper right corner, it is obvious that geominerology, geopedology and other lesser terms collectively form geolithology. Geolithology, in turn, is a lesser part of geophysiology which, with its companion, geopsychology, forms geology. But geology in this case has a somewhat different meaning from that of current usage for here it includes the social as well as the physical sciences of the earth. (As an aside, it might be noted that today's geology could more aptly be called geophysiology or even geolithology.) Geology and its descriptive companion, geogany, form geonomy which is defined as the study of all topics, physical and psychical, approached scientifically and descriptively, of the earth. Geonomy, in turn, fits into the overall structure of metaphysics (metonomy in the new terminology) as indicated in Figure 6.

But it is on geonomy that our interest as geographers should center. Here is a term which, with the exception of its being restricted to the region earth, includes both halves of the three major dichotomies noted earlier. Within the terminological framework established in this paper it is the smallest division of the study of the earth which can be established without running the risk of eliminating some subject matter of interest to geographers. As such, I submit that geonomy most clearly identifies the total interests of today's

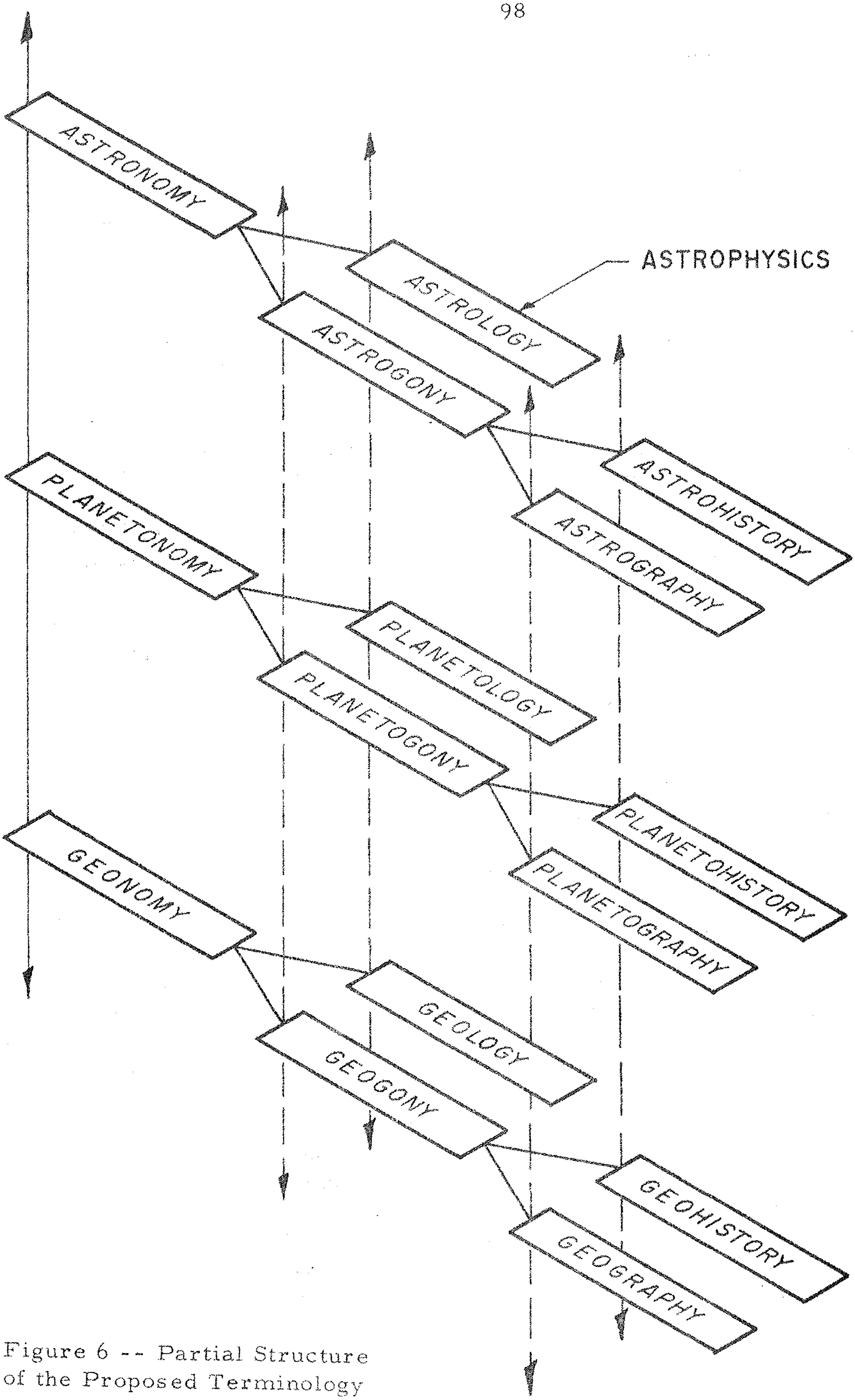
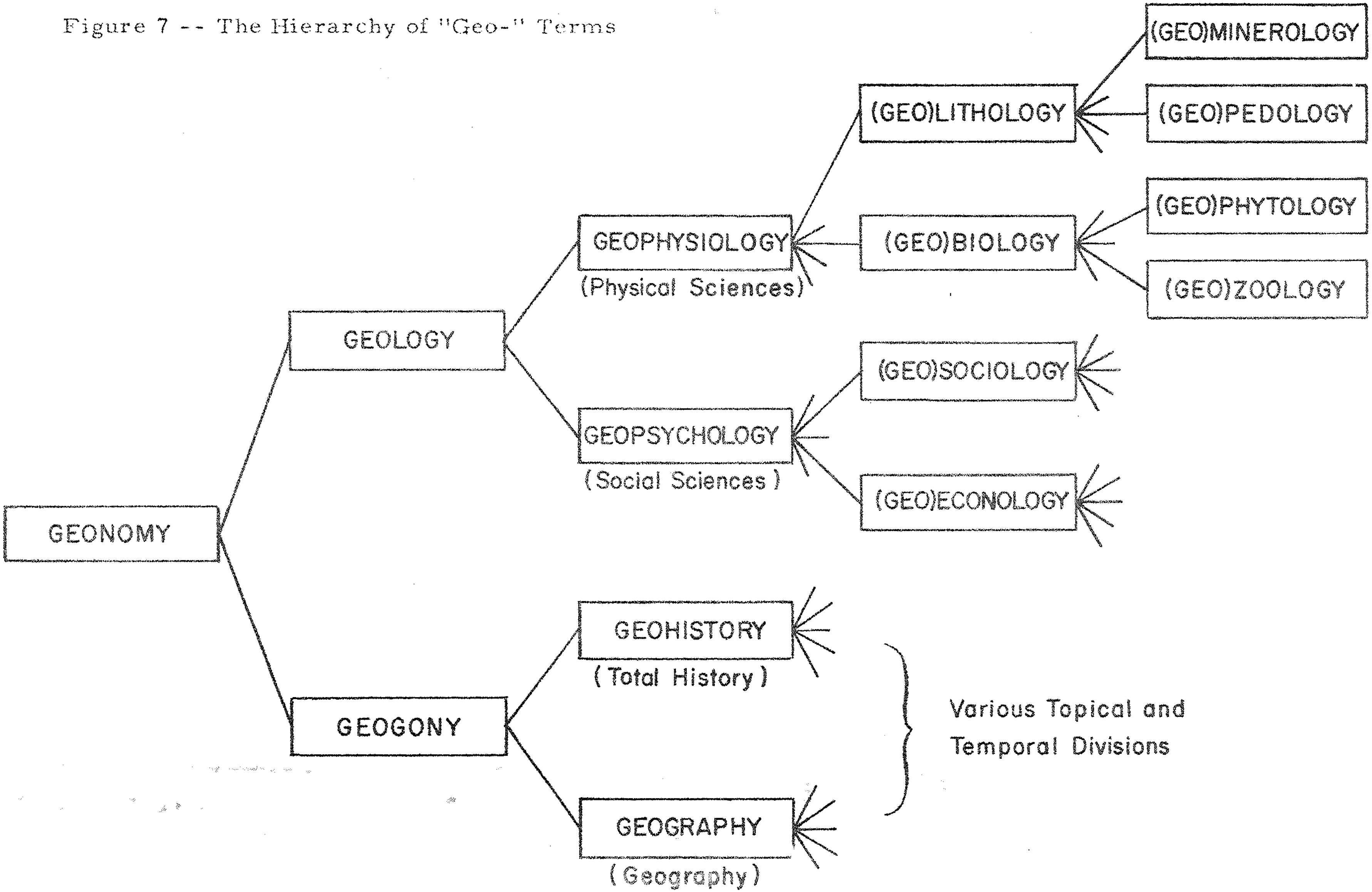


Figure 6 -- Partial Structure of the Proposed Terminology

Figure 7 -- The Hierarchy of "Geo-" Terms



geographers and, hence, the true field of geography. Further, I propose that this field be called geonomy and that today's geographers who pursue a wide variety of the subject matter contained in this field be called geonomers. This seemingly super title would not be meant to belittle those who pursue a "lesser field" in such depth that they are specialists identified by their particular field (i. e., geomorphologists, climatologists, sociologists, geographers, etc.). Rather, it would be to alleviate a communications problem and, at the same time, give merited recognition to those whose study of the earth combines both science and description and emphasizes breadth of subject matter as opposed to depth.

And as for the word geography, I propose that, as noted earlier and as shown in Figure 7, it be limited to identifying the spatially descriptive aspect of geonomy. In other words, geography would be that part of geonomy in which words, sketches, maps and graphs, etc., are used to create an accurate and communicable picture of the places and events of the earth in space and time, but primarily in space. This is the meaning nongeographers already attach to the word; and, in fact, it rather accurately defines the work of those geographers whose interests are primarily world and regional geography.

In closing, I would like to make a final comment. Although the word geonomy is not yet in the dictionary, it is already being used by both geographers[3] and geologists[4] - by the former as a new name for the science of economic geography and by the latter as the science of the non-living portion of the earth. In both cases the usage is too restrictive (better terms would be geoeconology and geophysiology, respectively). Nevertheless, the fact that geonomy is already being used, even if on a limited basis, should be of vital concern to all geographers. If either of these overly restrictive usages ever gains general acceptance, then, as today's geographers, we will find it even more difficult to escape the frustrating communications dilemma in which we presently find ourselves. For of all the words available, geonomy, with its obvious similarity to familiar words like astronomy, should be the easiest one for the public to accept and understand.

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[3] George T. Renner, "Some Principles and Laws of Economic Geography," Journal of Geography, Vol. 49, No. 1, January 1950, pp. 14-22.

[4] R. W. Van Bemmelen, "The Importance of the Geonomic Dimensions for Geodynamic Concepts," Earth Science Reviews, Vol 3, 1967, pp 79-110.

THE USE OF COMPUTER GRAPHICS IN THE HUDSON RIVER VALLEY

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Tarrytown, New York

In recent years, regional planning has come to be known as a panacea for the treatment of urban ills. Like most panaceas, the success of the application depends upon the type of illness; and, particularly, upon the ingredients in the remedy.

Similarly, regional planning agencies that encompass the land area of two or more local governments are thought to possess the components of an elixir that would "cure all." In fact, however, they usually have no power at all to bring about the cures they feel are needed. The control of land development, in the best American tradition, lies with local governments.

Consequently, the success of regional planning agencies as panaceas lies in their ability to persuade local governments that regional solutions to development are more important -- and can be better -- than the ad hoc decisions most local officials are prone to make.

To convince local officials of the validity of his solutions, the expert regional planner seeks to improve his technical ability to handle the many geographic, economic and social factors that underlie planning decisions. Eventually, after all the spells and incantations of economic, demographic and social research have been exhorted, the planner is forced to deal with the future use of lands in one form of development or another.

To do this, he needs to amass a great deal of information about the geography of the area he deals with, its topography, vegetative cover, land use, soil characteristics, population distribution, transportation (or accessibility, if you prefer) and other factors, all in a host of minor and major subcategories.

Until recently, only the laborious hand production of maps could provide geographic information in a suitable form. Even then, because of the time and cost involved, only a few of the more essential kinds of information were mapped, usually on a series of single maps and not as overlay systems.

Even when overlays were used, they allowed the planner to view simultaneously only a few geographic factors together; and, because of problems with multiple colors, patterns and the diminishing acuity involved in studying many overlays, even this approach reached a point of diminishing returns.

What has been clearly needed is a method to combine mechanically many geographic factors in some form of a map, but at a low cost and with rapid production. Computer Graphics systems, which are just beginning to break into the planning scene, hold promise in meeting these requirements. They also should bring new experts, new jargon and, hopefully, new solutions to the problems of regional planning and development.

Computer Graphics, we feel, can be a persuasive tool that could encourage local governments to abide by empirically-arrived-at decisions. How these systems have been developed and how they will be used by the Hudson River Valley Commission is the subject of this paper.

Mindful of the need for more sophisticated locational analyses, the staff of the Hudson River Valley Commission initiated a search for a Computer Graphics program that would offer satisfactory results within reasonable costs. SYMAP, the synagraphic system developed by Howard T. Fisher of Harvard University, seemed to be a program that offered promise.

The Commission's search, however, was for a method to analyze and display data from a data-rich source: The aerial photograph. Thus SYMAP, basically a system for data-scarce sources, had to be adapted to a source of plentiful information and provide the Commission with a useful and valuable basis from which to start in the development of a newer, more sophisticated program.

Even newer methods than those employed in SYMAP are being developed by the HRVC today so as to inventory and aggregate data in discrete, regularly spaced geographic areas for its entire 700-square-mile jurisdiction that extends from New York City to the source of the Hudson River at Lake Tear of the Clouds near Mount Marcy in northern New York State. If the length can be so stated, the width of HRVC's jurisdiction is far harder to state, for it extends inland from either bank of the River anywhere from one to two miles, depending upon whether the area is visible from the River or not.

The newer methods also enable the Commission to display its data in such a manner that combinations and rankings of the many diverse factors that are under study can be portrayed as the needs arise.

Data for the HRVC's land use, natural features and environmental condition programs will be extracted from many sources, including census information, questionnaires and field observations, but more particularly from aerial photographic interpretation. Presently, more than 95 per cent of the data are being obtained by simple pattern recognition of aerial photographs and by more elaborate stereo interpretations.

Most of the factors so identified do fall into present land use categories such as residential, commercial and industrial land areas, as well as recreational and transportation facilities. However, physical information, such as types of soil, slopes, geomorphological features and depth to bedrock, also are being plotted.

Coupled with these data are categories that identify peculiar but omnipresent cultural and physical variables that mark the landscape, such as building heights, paved coverage and landmarks.

An aerial survey made in April, 1967, is the Commission's basic photo source, providing about 4,000 pictures at a scale of 1" to 500' (1:6,000) coverage on 9"x9" photographs. Each photo has an overlap of 60 per cent in the line of flight (to permit stereoscopic viewing) and a side lap of 30 per cent from flight strip to adjacent flight strip.

Information is extracted from the photos by experienced interpreters, including geologists, foresters, geomorphologists, ecologists, landscape architects and geographers. The Center for Aerial Photographic Studies at Cornell University also is undertaking the interpretive program as well as the developmental program for the Computer Graphics system under contract with the HRVC.

A number of factors were important to the Commission in the selection of its Computer Graphics program for studying geographic factors in the Hudson Valley. Efficiency and economy in conducting the study, the broad scale of data obtained, and the ease of up-dating all were basic to the selection. In addition, the program had to permit the inclusion of additional data at any future time. Some of the proposed data that may be inserted into the program in the future will consist of sociological and additional census information.

The system of quarter-of-a-square-kilometer grids used to reference all data is part of the Universal Transverse Mercator (UTM) grid and can, therefore, be extended to other areas of the State. Moreover, the grid system and coding procedures used in the HRVC program are compatible with other studies the State presently is undertaking.

The quarter-of-a-square-kilometer grid, then, forms a basic screen to which all data can be referenced by coordinates and within which most land data can be measured, quantified and entered into the program format. Because of the scale of the mapping base, some generalizations occur. Any area below one acre, for example, will not be measured. But when data smaller than one acre is important, such items will be counted so that their presence is known even though the land area they cover is not.

Historic sites, churches and schools are examples of important land uses requiring a "presence" count rather than an area measurement. In contrast, the land area covered by single-family dwellings, factories, shopping centers and most other land uses will be measured.

Interpreted data is drawn directly on dimensionally stable drafting film overlays laid on United States Geodetic Survey 7½-minute quadrangle maps. The data then is measured by area on a Model 303 Calma digitizer, on which the operator manually traces the outlines of areas marked out on the overlay by using a stylus. The movements of the stylus are transmitted to magnetic encoders that convert stylus movement to land area calculations in the form of digital signals.

These signals are processed and forwarded for output recording on a digital incremental recorder. With the completion of the digitization, the tape is formatted to the mapping program that will cover the Commission's entire jurisdiction.

After all areas have been measured, point sources identified and the data compiled into the mapping format, processing can begin. Essentially, the program permits computations of data and their display and combinations for each quarter-of-a-square-kilometer grid cell. Output is shown in ten dark-through-light shadings, achieved by overprinting standard computer printout symbols on output paper. Place names, landmarks and the like can be included in the printout as reference points.

The Computer Graphics program will be used primarily to solve land use locational problems. The best sites for specific kinds of industry, for shopping centers, parks, power plants and even for marina sites can be handled by the program, providing all significant locational variables have been mapped.

Whether an area of land is appropriate for development of homes, industry in its various forms, a shopping center, park or any other kind of development depends on the physical factors present (slope, geology, vegetation, etc.) and on the type and extent of existing and adjacent development. The HRVC has 150 such factors inventoried and the Computer Program permits the combination of any number of them.

Even more important, if some of these factors need to be emphasized more than others in a given situation, weights can be added. For example, in selecting a site for a shopping center, if access to a major highway is important, and a site with no swamp or bog is desired but not as important, the computer map will show all areas where these two factors are present and it will assign a heavier weight to those areas that have a highway in them.

In actual practice, the number of factors considered may range up to 40 to 50, with weights assigned as desired. Moreover, the program is written so as to allow up to 300 additional variables to be entered. These additions will be accomplished as more time and funds become available.

For any of the locational studies the Commission might wish to undertake, it would proceed by collecting empirically derived sets of variables from the basic lists. Specifically designed graphs would be drawn for each of those variables. These graphs would portray the relative weight a factor possesses in relation to the study object. The weighted graphs would be combined during the computer run so that the output would show all grid cells arranged in ten light-to-dark shadings that would be equivalent to low-high rankings anywhere in the Commission's jurisdiction.

As an indicator to the best possible sites for analysis, more and finer variables could be added for specific areas. This type of analysis could be refined still further as the number of variables increased and was updated.

The program being developed by the HRVC, and it is still nameless to date, possesses many of the basic capabilities of its predecessor, SYMAP.

Those capabilities are great and include the following:

1. Enlargement or reduction of the computer map in scale.

2. Printing of a map legend.

3. Computer printing of place names, landmarks, stream names, etc.

4. Performance of mathematical data prior to mapping.

5. Classifications of data up to ten levels.

6. An automatic histogram showing frequency of data distributions.

7. Maps indicating the areal coincidence of a number of variables.

8. Comparison of two or more printout results for further analyses.

9. Simplicity, that is, orientation toward users rather than theorists, so that the system can be manipulated by anyone with a minimum of computer knowledge.

It is evident that newer methods are needed and are being developed for the geographer, the urban planner and others interested in understanding important but hitherto elusive relationships among land use and environmental factors. The reasoned assignment of relative values and weights to important variables can be helpful in locational decision making. Computer Graphics can, we think, offer the means by which those decisions may be substantiated.

AN HISTORICAL GEOGRAPHIC STUDY OF A MID-HUDSON VALLEY CITY: NEWBURGH, NEW YORK

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The Physical Setting

The City of Newburgh, New York, is located in the Mid-Hudson Valley which is part of Fenneman's Valley and Ridge physiographic province.[1] At this location, the province lies generally astride the Hudson River and is ten to thirty miles in width; south of Newburgh it veers off to the southwest and extends through the states of New Jersey and Pennsylvania and on to Alabama. In the past this province was not only an important corridor for overland movement to the southwest, but was also an important agricultural area. (See Map 1.)

To the south the region of the Mid-Hudson Valley is bordered by a section of the New England Province, the Reading Prong, which crosses the Hudson River in a northeast to southwest direction and except for the river is a definite barrier to north-south movement. To the east the region is bordered by the Taconic Mountains of the New England Province and to the west by the Appalachian Plateau.

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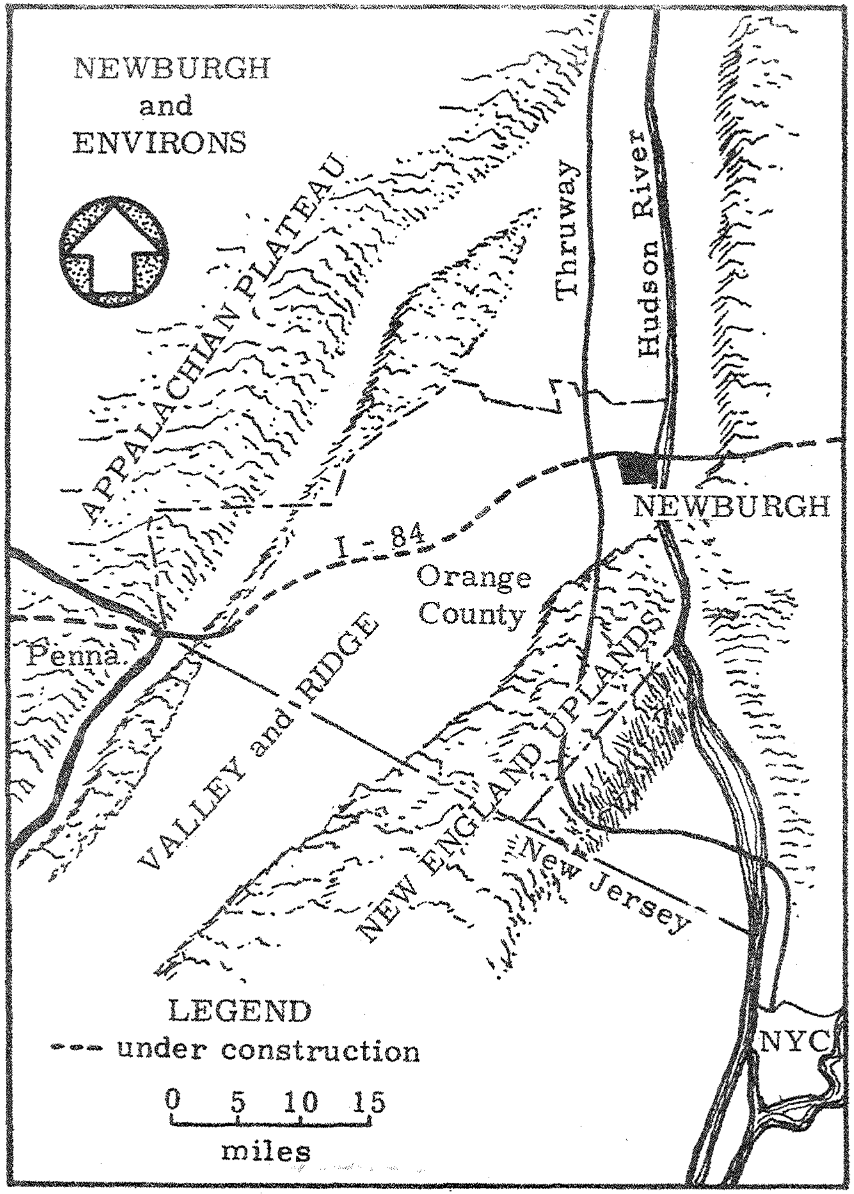
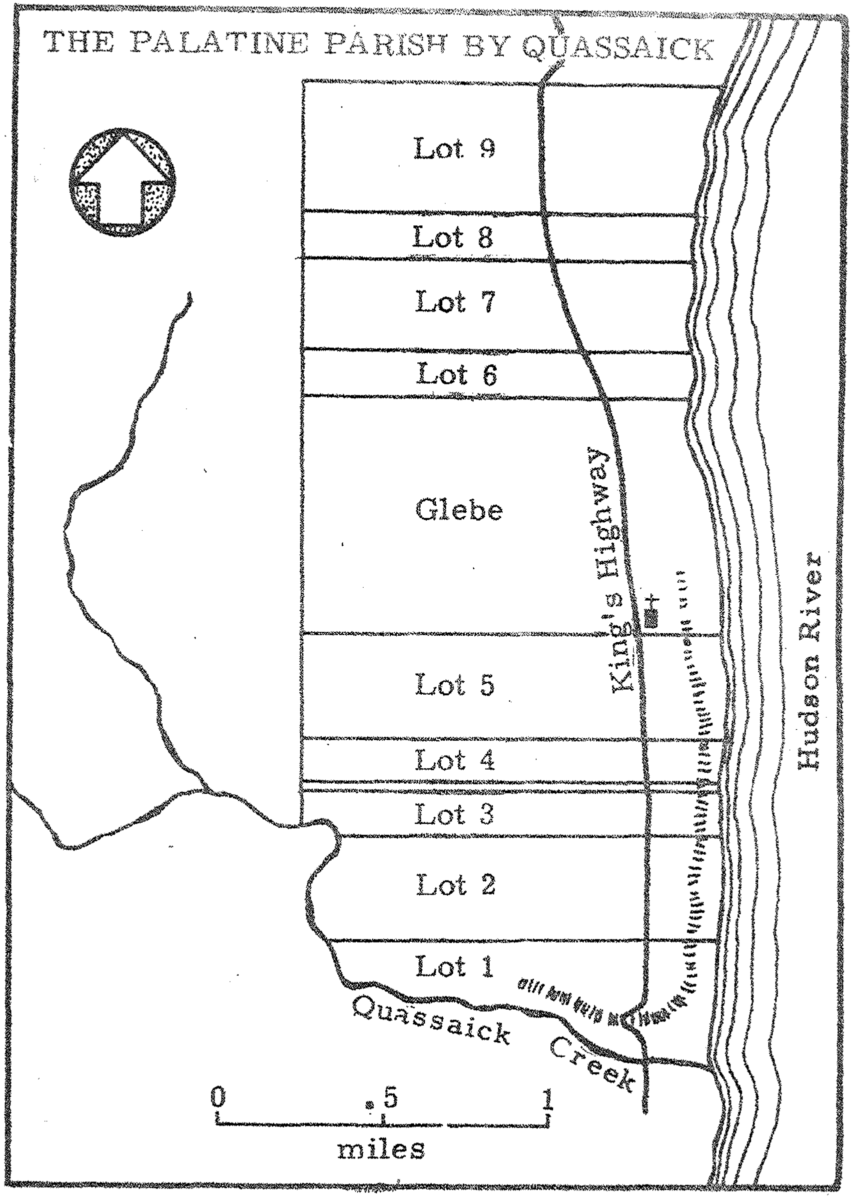
[1] Nevin M. Fenneman, "Physiographic Divisions of the United States," Annals of the Association of American Geographers, Vol. 18, 1928, pp. 253-261.


NEWBURGH
and
ENVIRONS
APPALACHIAN PLATEAU
Thruway
Hudson River
NEWBURGH
I - 84
Orange
County
Penna.
VALLEY and RIDGE
NEW ENGLAND UPLANDS
New Jersey
NYC
LEGEND
--- under construction
0 5 10 15
miles

Map 1


THE PALATINE PARISH BY QUASSAICK
Lot 9
Lot 8
Lot 7
Lot 6
Glebe
Lot 5
Lot 4
Lot 3
Lot 2
Lot 1
King's Highway
Hudson River
Quassaick Creek
0 .5 1
miles

Map 2

There is striking evidence that the surface features of the entire region were exposed to the continental glaciers of the Pleistocene period. As a result of this glacial activity, many glacial terraces line the main valleys. The site of Newburgh is on a kame terrace which is about 150 feet in elevation, with steep fronts facing the Hudson River to the east and the Quassaick Creek to the south. Due to the continental ice sheets the topography west of the city may be described as a very persistent and gently rolling surface with scattered rounded hills 100 to 300 feet high. Still another influence of glaciation is that the mature residual soils that once covered the region were scraped off and a deposite of rocky glacial material was substituted. Therefore, today the soils of the region are rocky, gray-brown podzolics which are leached and somewhat acid due to the humid cool climate.

The Colonial Period

The initial European settlement on the site of present day Newburgh was made by a group of nine German families from the Palatinate region of the middle Rhine. They were religious exiles, Lutherans, whose villages, homes, and farms had been destroyed during the European wars at the beginning of the Eighteenth Century. The initial Palatine group left their ancestral homes on the middle Rhine in February 1708, going first to Holland and then on to England where the Crown sponsored their transportation to and settling in the New World. Initially, the English Board of Trade suggested that they settle in Jamaica or "Antego" (Antigua), where large tracts of land were still ungranted and the need for European settlers existed. However, fear of the adverse affect of the tropical climate on the Germans led to the suggestion "that they be sent to Settle upon Hudson's River in the Province of New York".[2] In addition, the English thought that these new settlers could manufacture naval stores for the Royal Navy and strengthen the frontier throughout this region.

After a nine week voyage, the Palatines arrived in New York in December 1708. They were encouraged by Governor Lovelace to remain in New York until spring, since it would have been difficult to establish a settlement during the winter. Therefore, it was not until early 1709 that the Palatines actually occupied the site

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[2] The Documentary History of the State of New York, ed. E.B. O'Callaghan, Albany, Weed, Parsons and Company, Vol. 3, 1850, p. 542.

of their new home on the west side of the Hudson River, fifty-five miles north of New York. Their grant, called "The Palatine Parish by Quassaick," was along the bank of the Hudson River, running north from the point where the Quassaick Creek flows into the larger stream. In pursuance of Governor Lovelace's instruction each settler, regardless of age, was allotted fifty acres and an additional five hundred acres was granted for a glebe.[3]

There are no known records that indicate exactly how much land the settlers occupied and where they farmed; therefore, how they divided the patent if at all is uncertain. However, it was probably a community life based on a subsistence economy of agriculture and some hunting and fishing.

Four years later in April 1713, Mr. Augustine Graham, the Surveyor General of the Province of New York, was instructed to survey the site. His obvious solution was geometric in principle and required little if any field surveying. To allot fifty acres for each man, woman, and child, Graham laid out the western boundary one hundred chains west from and parallel to the Hudson River. Then starting at the Quassaick Creek as the south boundary, every five chains that were marked off along the river meant five hundred square chains which is fifty acres -- the allocation for each individual in the settlement. In this manner he marked off nine lots and a glebe. (See Map 2.)

The formal patent officially embraced 2190 acres as laid out by Graham's survey and was granted in December 1719, over ten years after the Germans arrived on the site. The total personal allotment plus the five hundred acres for the glebe amounted to 2150 acres; forty acres were set aside for public roads. Exactly half of these forty acres were taken up by a wide street, two chains, or 132 feet in width, placed between Lots 3 and 4, and the remaining twenty acres were located in a north and south street running across the entire patent.

Several errors have come to light in the total acreage. Quassaick Creek, which formed the southern boundary, instead of running straight west from the river, at right angles, as Graham assumed, runs in a very crooked line as indicated on the map. Therefore, Lot Number 1, which supposedly contained 250 acres, certainly had far less than this amount.

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[3] Ibid., p. 574.

Cadwallader Colden obviously was aware of this error. He was a local man and his own land was not far from this patent. There is little doubt that he had this case in mind when in 1732 he wrote:

> Several of the great Tracts lying on Hudson's River are bounded by that river, on the east or west sides and on the north and south sides by Brooks or Streams of Water which, when the country was not well known, were supposed to run nearly perpendicular to the River as they do for some distance from their mouths, whereas many of these Brooks run nearly parallel to the river and sometimes in a course almost directly opposite to the River. This has created great confusion with adjoining patents, and frequently Contradictions in the boundaries, as they are expressed in the same patent.[4]

Additional errors were committed in the actual laying out of the survey. Lot Number 4 was marked off along the river a distance of eleven chains instead of the ten that were originally intended, and the glebe was measured as fifty-seven chains instead of fifty.[5] Thus a total of eighty acres was involved and this error was perpetuated in official documents which continued to refer to the patent as containing 2190 acres.

There are no records which indicate where individual families located their houses and barns, nor are there records of commercial activities on the river. The north-south road, called King's Highway,[6] undoubtedly was the main local route. About 1730 the initial settlers built their church on the glebe and it was located on this road near the boundary with Lot Number 5. (See Map 2.) Their houses and farms most likely were located along this north-south axis and the church may have been the nucleus of the settlement.

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[4] Cadwallader Colden, "The Lands of New York," Ibid., Vol. 1, pp. 383-4.

[5] Raphael A. Weed, "A Few Straight Lines," Historical Society of Newburgh Bay and the Highlands, Vol. 23, 1930, p. 9.

[6] In the Colonial Period, public roads were commonly referred to as King's Highways.

Soon the individual Palatine families abandoned the region and by the middle of the Eighteenth Century these lands were occupied by a second generation of Americans of Scottish, English, and Irish descent. As already mentioned, the original German settlement contained only nine families. In addition to being small, it was remote from the main regions of German settlements which were in Pennsylvania, further up the Hudson Valley, and on the frontier in the Mohawk and Susquehanna Valleys. Obviously, the Palatines would want to be in closer association with these larger groupings rather than in an isolated enclave. A more widely accepted reason for their departure from the region is that these early settlers were dissatisfied with the soil, which was not fertile enough, and they moved elsewhere to farm a more productive soil; the Palatines were farmers and certainly sought fertile lands for themselves and their posterity. But less than twenty miles to the southwest of their settlement lie the rich "black dirt" regions of Orange County, old glacial lake beds with rich organic soils. The Germans may not have been aware of the agriculture potential that existed such a short distance away, but more likely they were looking for an excuse to join their former countrymen.

The Early American Period

Throughout the Revolutionary War, an important aspect of the geography of the region was the role played by the Great Valley, which leaves the Hudson River at Newburgh and runs to the southwest. (See Map 1.) During the war the valley became a main line of the overland communication between New England and the Middle Atlantic Colonies.[7] As already mentioned, the Hudson Highlands, a section of the New England Uplands, provided a natural barrier to any movement from the south into the Great Valley; therefore, the Highlands and the control of the Hudson River, which traverses the mountains, took on considerable military importance. General Washington fortified the Highlands to protect the Colonies' overland line of communication, which had its main crossing point on the Hudson River at Newburgh.

The location of the commissary department for a large part of the Continental Army was located at Newburgh and the Continental Ferry was in operation on the river. The initial patent for a ferry

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[7] Kemble Widmer, Geology Field Trip of the West Point Area, West Point, Department of Earth, Space and Graphic Sciences, 1967 p. 9.

at this location was granted in 1743 to Alexander Colden, who was one of the second generation of Americans that replaced the earlier Palatines. These new residents of Newburgh were entrepreneurs, who were active in commerce in addition to their agricultural interest.

After the British defeat at Yorktown, Washington moved his army to the Newburgh area, a position that was centrally located on his main line of communication. He established his headquarters in Newburgh and accompanied by Mrs. Washington lived there from April 1782 to August 1783, when the peace became official.

A significant increase in the population of the settlement did not occur until the Revolutionary War and at that time the area was popularly known as Newburgh. Incorporated in May 1800, the village then had a population of 3258. Several factors caused the rapid increase in Newburgh's population; first, the long encampment of the patriot army; second, the many refugees from New York City who settled in the area; and third, perhaps the most important, the site was at a major crossing on the Hudson River.

After the war, the ferry crossing became the focal point of a developing turnpike net. First came the Newburgh and Cochecton Turnpike. It took the route of the public road two chains in width, then called Eight Rod Road, which had been surveyed by Augustine Graham, and extended due west. The turnpike was laid out in a direct line over hills and through valleys, crossing streams and marshes, and penetrating forests until it reached Cochecton on the Delaware River. There it continued until it re-entered New York at the Great Bend of the Susquehanna River. It was advertised as the fastest route between New York and Buffalo even after the opening of the Erie Canal in 1825.[8]

Other turnpikes quickly followed. The New Windsor Turnpike led to the south. The Snake Hill Turnpike to the southwest intersected every road that led toward the river ports of New Windsor and Cornwall. To the northwest, the Plattekill Turnpike provided direct communication to the growing agricultural region of southern Ulster County. Newburgh became a place of transfer from these new land routes to the water route which led south to New York City.

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[8] Newburgh Telegraph, Newburgh, July 17, 1834.

The turnpikes were used to move large droves of livestock, especially cattle and hogs, and wagons loaded with agricultural products. The farmers of the hinterland established a highly profitable trade in butter, which was hauled from the farms in covered wagons to Newburgh, where it was placed on boats and barges and transhipped down the Hudson.

In Newburgh, docks and storehouses offering adequate facilities for the handling of agriculture commodities and merchandise began to replace the old, crude, and inadequate constructions of earlier days. On every side there were signs of rapid and substantial growth. A public market was opened; public hay scales were erected; provisions were made for a public water supply. The village had printing offices, hotels, taverns, banks, general stores, a hat manufactory, a brewery, and an iron foundry in addition to about 800 dwellings. New streets were laid out and old ones extended to accommodate Newburgh's growth and expansion.

Water Street, which serviced the wharves, docks, and warehouses, became the central business district. Gordon describes Water Street in his Gazetteer of the State of New York as follows:

> This main street of Newburgh presents, on market days, the thronged appearance of a busy metropolis, being crowned (sic) with teams, and its large stores filled with dealers. The trade with New York employs continually seven sloops and five steamboats, owned here, and many other vessels, occasionally.[9]

While Newburgh was growing to meet the demands of its prosperous hinterland, the westward migration of the United States was taking place. The Newburgh Ferry became one of the most active on the Hudson River, for it was part of a popular route that colonists from Connecticut and New England followed to the Northwest:[10]

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[9] Thomas F. Gordon, Gazetteer of the State of New York, Philadelphia, Thomas F. Gordon, 1836, pp. 605-606.

[10] Henry N. MacCracken, Old Dutchess Forever!, New York, Hastings House, 1956, p. 458.

> It was no unusual sight to see the long baggage trains conveying the household goods of these rugged pioneers seeking settlements in the ... West, ferried across the river and winding their way up the old wagon road towards the Snake Hill Turnpike, at the entrance of which stood for many years the sign board directing with index finger "To Ohio".[11]

Newburgh was located on a significant point in the region's transportation network and it was growing in size and stature.

The Queen City Era

The opening of the Erie Canal in 1825 had a negative effect upon the prosperity of the town. The commerce of a wide area was diverted from Newburgh as it turned toward the nearer and cheaper route of the canal. Roads were now built as feeders to this new transportation artery, when previously they had been built to connect with the Newburgh turnpikes.

The Delaware and Hudson Canal, which opened in 1828, encroached further into the natural hinterland of Newburgh. Finally, the New York and Erie Railroad was planned. Even though leaders of the village made vigorous political efforts to secure the eastern terminus of this rail system at Newburgh, Piermont was selected, resulting in more adverse results to the village of Newburgh. However, in 1850 a branch line of this great railroad was constructed to Newburgh, thereby ensuring the prosperity of the community.

The town was forced by these new conditions to solve new problems. It was at this time that larger manufacturing plants, factories, and industries were induced to come to Newburgh. A strong stimulus to these young manufacturing enterprises and the town's growth occurred in 1861 as a result of the Civil War. By 1865 Newburgh had a population of over 13,000 and on April 22 of the same year it received the status of a city.

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[11] William K. Hall, Address given at the one hundredth anniversary of the incorporation of the village of Newburgh. Historical Society of Newburgh Bay and the Highlands, Vol. 7, 1900, p. 22.

A few years later, the Dutchess and Connecticut Railroad, which connected the east shore of the Hudson River opposite Newburgh with the New England states, was completed. Free connecting railroad ferry service was established and Newburgh became a gateway on a direct route between the Pennsylvania coal fields and the New England market. Every coal field in the state of Pennsylvania had railway connections with Newburgh. The Wyoming field used the Erie and Wyoming Railroad and then the New York, Lake Erie and Western by the way of Port Jervis. Coal from the Lehigh and Schuylkill fields came by a route that passes through Phillipsburg, New Jersey and from there the Lehigh and Hudson Railroad carried it toward Newburgh.

The railroad ferry across the Hudson was only one facet of the coal traffic. Newburgh became one of the largest depots for coal in the East. The city was the closest tidewater port to the coal fields previously mentioned and coal was being shipped from Newburgh by cheap water transportation to various places throughout the Northeast. Long strings of river barges carrying coal left daily going both north and south; they traveled to ports on the Long Island Sound and the New England Atlantic Coast, and to Hudson, Troy, and Albany on the Hudson River where the coal was transhipped by rail to inland eastern towns. Some boats even traveled west on the Erie Canal to Buffalo and from there coal was reshipped to various lake ports.[12]

The multiplying rail facilities and excellent connections with the whole Northeast attracted additional factories and industries. These included planing and saw mills, shipbuilding, and the manufacturing of machinery and clothing.

Analyzing the organization of the city at this time, we see Water Street continuing in its role as the central business district. However, commercial activity was spilling over and extending west along Broadway, the new name of the original road surveying by Graham almost two centuries earlier. The route of the railroads from the west to the river front was down the modest gradient of the valley of Quassaick Creek on the south edge of the city. In addition to accommodating the railroads, this stream was the major source for water power in the area which resulted

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[12] John J. Nutt, Newburgh: Her Institutions, Industries and Leading Citizens, Newburgh, Ritchie and Hull, 1891, p. 225.

in a concentration of mills and factories in the Quassaick Valley. The initial grist mill that was built on the Quassaick is shown on Simon DeWitt's map of 1783.[13] Another desired location for factories was the river front, adjacent to the shipping industry's piers, wharves, and warehouses.

New residential districts were developed and public services expanded. The largest and most desirable residential district was known as "Washington Heights" which sprung up from the fields and pastures on the large terrace in the southeast section of the city overlooking both the Hudson and Quassaick. New schools and churches were built; one of the first free public libraries in the State of New York was established; a hospital was placed in operation; a fine public park was laid out; and a street railway was operating throughout the city. This was Newburgh at the end of the Nineteenth Century: the "Queen City of the Mid-Hudson Valley".

The Recent Period

Today, Newburgh is still the major trading center of Orange County. The famous Hudson River fruit belt, which largely serves the New York market with its fruits, berries, and wines, lies to the north and west of the city. The old glacial lake beds among the largest fields of "black dirt" in the East, lie to the southwest and produce onions, lettuce, and celery. The annual value of the farm products in Orange County in 1964 was $30 million. Dairy products, still the number one agricultural money earner, account for half of this figure and vegetables account for another quarter.[14]

The factories of Newburgh employ many people and manufacture a great diversity of products which include metal products, textiles, wearing apparel, women's handbags, chemical coated fabrics, and wool felts. However, today the biggest single employer in the immediate area is the Federal Government. Stewart Air Force Base, which lies two miles west of the city, has an annual

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[13] Simon DeWitt, The Winter-Cantonment of the American Army and Its Vicinity for 1783.

[14] Orange County Data Book, 1968, Goshen, Orange County, 1968, p. A-3.

payroll of over $14 million.[15] In addition, many citizens are gainfully employed at the United States Military Academy at West Point, New York, eight miles down the Hudson.

The creation of a network of modern highways is currently influencing the economic and cultural life of the city. Initially the federal, state, and local roads focused on Newburgh and the ferry. However, the recent express highways and even those still under construction no longer converge directly on the city. (See Map 1.) In 1954 the Governor Thomas E. Dewey Thruway, which passes just a little over a mile west of the city's boundary, was opened to traffic. Its effects on Newburgh were many. First, it helped relieve the congested traffic in the city by separating the north-south through traffic from the local traffic. It also greatly improved the accessibility of Newburgh both to and from the north and south. On the negative side, it proved to be a powerful force pulling business and commercial activities away from the river front and the old central business district on Water Street.

In 1963 the Newburgh-Beacon Bridge, a section of Interstate Highway 84, a major east-west route in the near future, was opened and the Newburgh Ferry, which was a fixture on the river for 220 years, was closed. Almost instantaneously the old central business district, which was centered on Water Street, died. Today, this old business center has become the major ghetto of the city. Decay is creeping west along Broadway, that wide thoroughfare that once was the city's pride.

Ironically, while Orange County's population is one of the fastest growing in the New York State, Newburgh's has fallen from 31,000 in 1960 to 27,000 in 1967.[16] This is a phenomenon that is common to the American scene; however, part of the stimulus for growth in the county is from the spread of the New York Metropolitan Area which has also contributed to the industrial expansion throughout the region. Meanwhile, since the late 1950's the fruit and vegetable farms of the region have been using great numbers of migrant workers from the South and Puerto Rico. Many of these workers and their families have moved into the decaying sections of Newburgh and have become permanent residents.

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[15] Greater Newburgh Chamber of Commerce.

[16] Ibid.

Today, in the city's population of 27,000 there are 8,000 Negroes and 4,000 Puerto Ricans.[17] These two groups represent 44 per-cent of the total population.

Like cities elsewhere in the country, Newburgh is in turmoil. The city has the social problems of housing, education, and employment compounded by segregation. But in addition to the exodus of the higher social-income segment of the population to the suburbs and the lower segment flooding the central city, Newburgh is undergoing a complete reorientation of its central business district. For two centuries it was on the east side and closely associated with the river front and the ferry. Today it is being attracted to the west side by modern express highways, some of which are still under construction. These are the forces of today that are shaping the future geography of Newburgh.

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[17] Ibid.

THE GEOGRAPHY OF RELIGIOUS GROUPS IN NEW YORK, PENNSYLVANIA, AND OHIO

PERSISTENCE AND CHANGE, 1890-1965

Stephen W. Tweedie

At the end of his paper on the religious geography of the United States, Wilbur Zelinsky[1] suggests several avenues for further research. One of these is "the statistical analysis of areal association on a national or regional scale involving such religious statistics as we have and relevant demographic, economic, and social statistics". This approach "though beset by many statistical pitfalls occasioned by the feebleness of much of the basic information, is greatly to be commended to those who are amply supplied with both technique and caution."[2]

With this warning in mind, I have plunged into the nether land of religious statistics, and, armed with the SYMAP computer mapping program, have attempted to follow the lead given by Zelinsky, and make a careful and detailed statistical analysis of patterns of religious identification for a portion of the United States.

It is hoped that this study will be a demonstration of the value of computer mapping to historical cultural geography. With the technological breakthrough provided by SYMAP, which enables one to identify, quickly and accurately, spatial patterns from a large amount of data, this is, for the first time, a feasible project.

The study area consists of Ohio, Pennsylvania, and upstate New York, a choice made mainly for practical reasons. The area was small enough to be workable, yet large enough to result in interesting patterns using county data. In addition, for each of the three states, the State Council of Churches had collected membership statistics between 1960 and 1965, thus providing a recent picture of religious identification.

The time interval under consideration was determined by the availability of membership statistics. These were first collected by the United States Census Bureau in 1890. Using varying criteria and methods, the Census Bureau continued to collect membership data in 1906, 1916, 1926, and 1936, with results varying in completeness and accuracy. Around 1952, the National Council of Churches took its own survey of church membership. For this paper, I have used the 1890 U.S. Census figures, and the 1960-65 figures collected by the respective State Council of Churches.

The present paper will be concerned with only five major groups -- Episcopalians, Presbyterians, Methodists, American Baptists, and Roman Catholics.

At this point, I would like to consider briefly what has been done in the mapping of religious groups during this time period, and to point out the innovations which I have made in hopes of achieving a better understanding of the patterns involved.

The first major attempt to map religious groups by membership was made by Henry Gannett in connection with the 1890 census.[3] Gannett presents national maps showing membership as a percent of population, by county, for most of the major denominations.

The next major contribution is the paper by Wilbur Zelinsky,[4] in the Annals of the AAG in 1961. Zelinsky, using data collected by the National Council of Churches, produced national maps of absolute membership, by county, for all major groups, plus one map showing Roman Catholics as a percentage of total church membership.

Shortly after Zelinsky's paper, Edwin Gaustad completed his Historical Atlas of Religion in America.[5] Gaustad's maps, for the most part, are based on number of churches, with the exception of his summary map which shows the leading group as a percentage of total church membership, by county, for the United States.

In attempting to use the maps provided by these three scholars to study historical trends, one soon encounters problems due to differences in methodology. A comparison of maps based on percentage of population in 1890, with those based on absolute membership in 1950, or with maps based on number of churches, can yield only very tentative conclusions. An additional problem arises in comparing denominational maps, since none of the authors attempted to adjust the data to correct for differing definitions of membership. I do not want to give the impression that they were unaware of this problem, but rather that it is a problem which has not yet been treated.

I have attempted to account for these differences in membership criteria by using estimates of membership age 13 and over, published by the U. S. Census in 1916 and 1926,[6] and estimates of baptized versus communicant members provided by the National Council of Churches in 1952.[7] In calculating percentages, I have used estimated adult population (age 13 and over) rather than total church membership as the base, in order to obtain a more realistic appraisal of the strength of a group. To overstate the case, if out of 100 people, one is a Methodist and one a Catholic, it is more significant to know that only 1% of the people are Methodists than to know that 50% of all church members are Methodists.

It cannot be denied that estimating adult membership is a potential source of error, but in the light of the many reservations which scholars have about church statistics, any additional loss in accuracy should be more than outweighed by the potential gain. In my opinion, the maps more than justify these procedures, and amply demonstrate the value of using available religious statistics in spite of their shortcomings.

The remainder of the paper is devoted to a discussion of the maps for the five groups under consideration. Table 1 gives the membership data for the groups during this time period.

Table 1

Group	Adult Membership[8]		Percent of Adult Population	
	1890	1965	1890	1965
Episcopalian	128042	379079	1.46%	1.80%
American Baptist	246374	294288	2.81	1.39
Presbyterian	407366	1030405	4.65	4.87
Methodist	642624	1509185	7.34	7.14
Roman Catholic	1270977	4767048*	14.51	25.80*

* data for 1950

Figures 1 and 2 reveal that Episcopalian strength in the area is largely limited to New York, and northern and eastern Pennsylvania, with a zone of weakness running parallel to the Hudson Valley. Although growth is evident, the "core" areas of 1890 have remained, for the most part, the more prominent areas in 1965.

The Baptist maps (Figures 3 and 4) reveal quite a different picture. Although Baptists have achieved a slight membership gain during the period, they have sustained a severe loss in percentage of adult population. Only 88 counties, out of 208, reported an increase in membership, and only 31 counties showed a percentage increase. The maps reveal this decline. In 1890 the areas of Baptist strength extending across upstate New York from Washington county, northeast

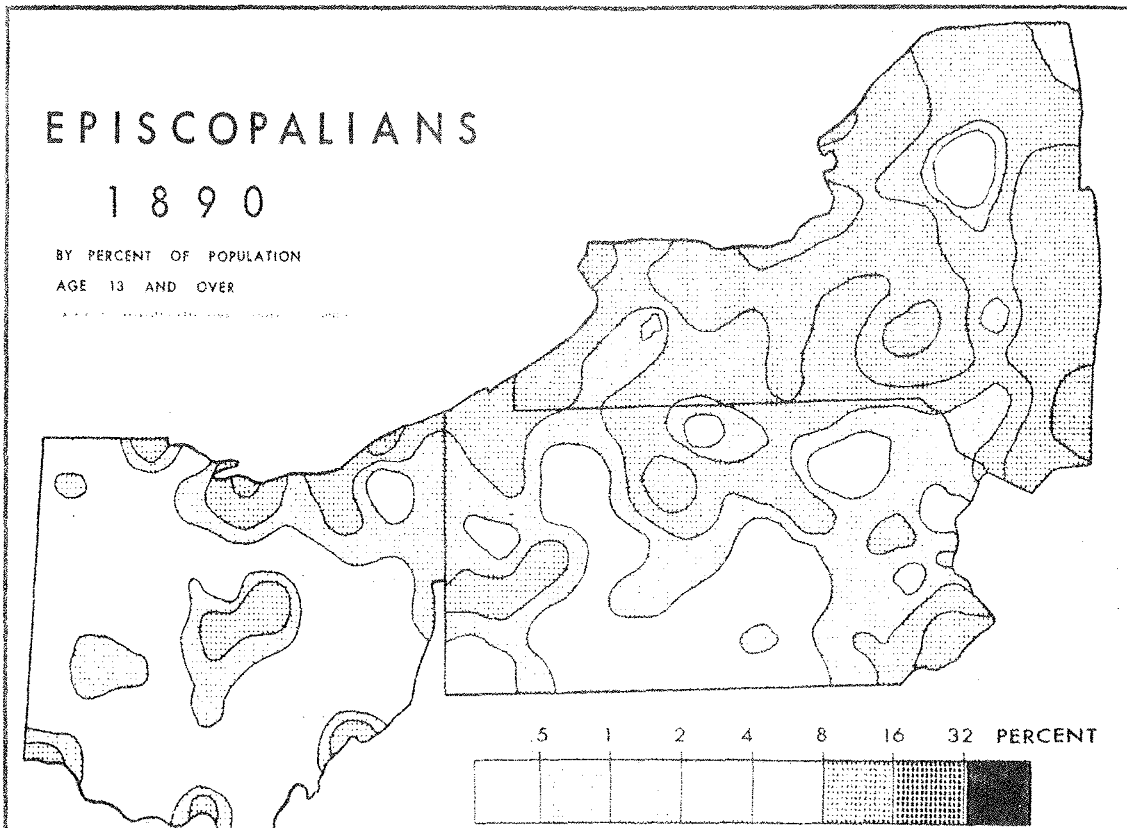

EPISCOPALIANS
1890
BY PERCENT OF POPULATION
AGE 13 AND OVER
.5 1 2 4 8 16 32 PERCENT

Fig. 1

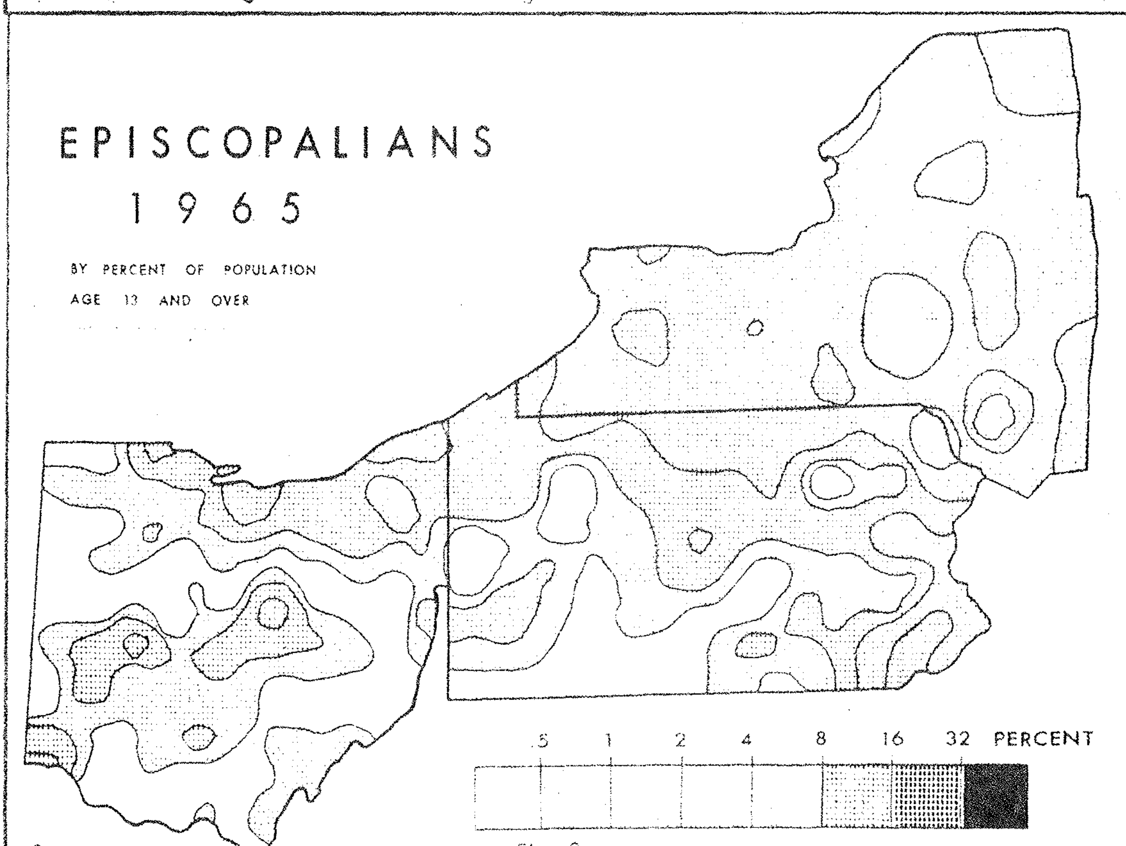

EPISCOPALIANS
1965
BY PERCENT OF POPULATION
AGE 13 AND OVER
.5 1 2 4 8 16 32 PERCENT

Fig. 2

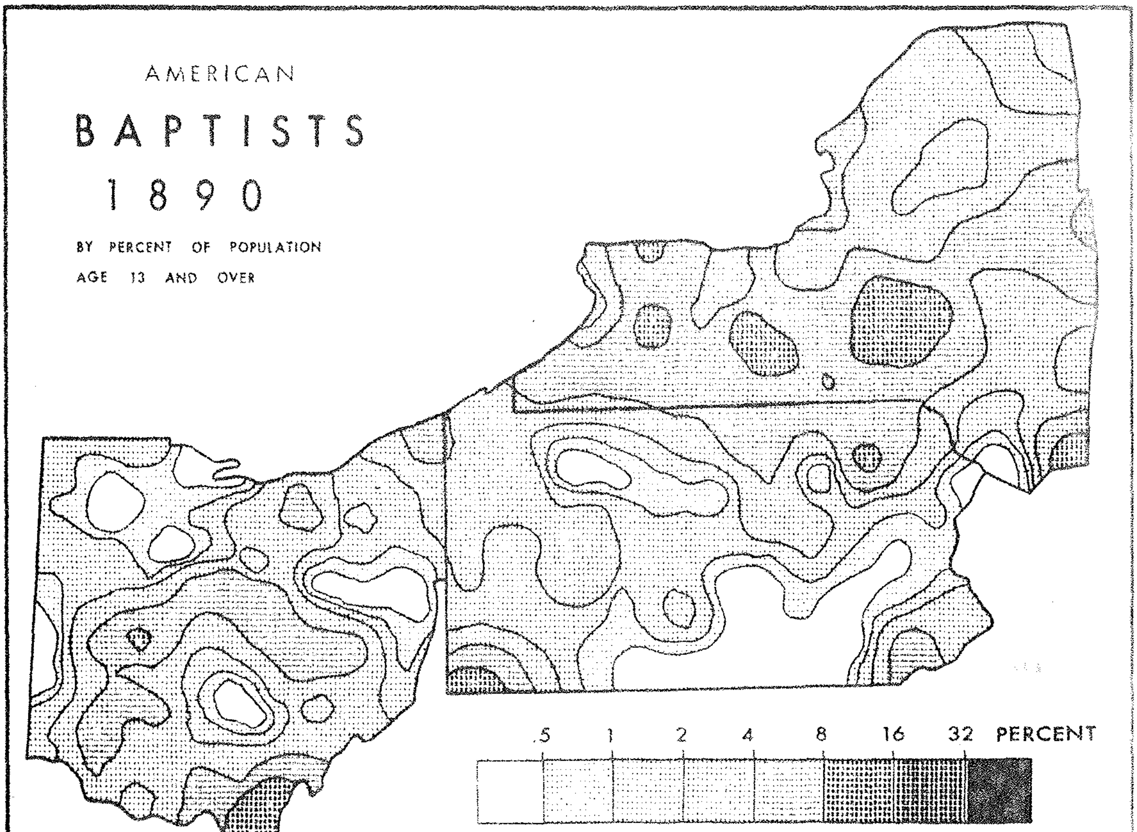

AMERICAN
BAPTISTS
1890
BY PERCENT OF POPULATION
AGE 13 AND OVER
.5 1 2 4 8 16 32 PERCENT

Fig. 3

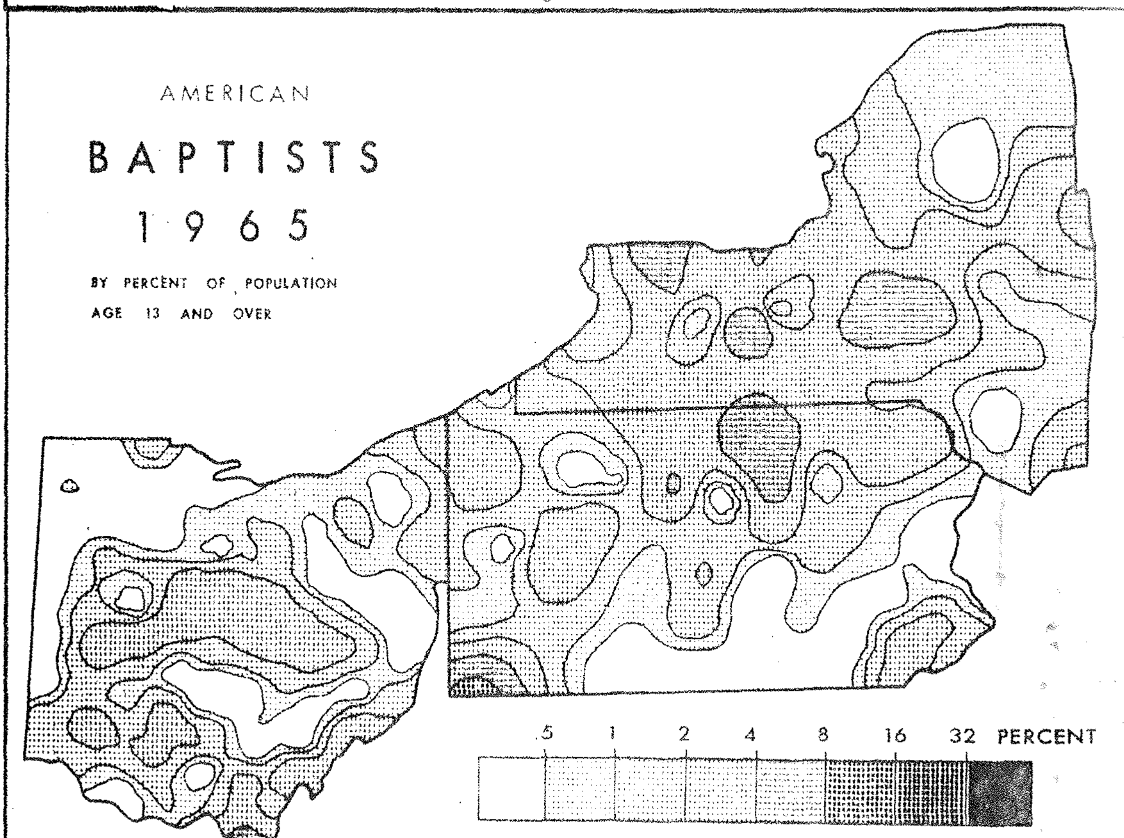
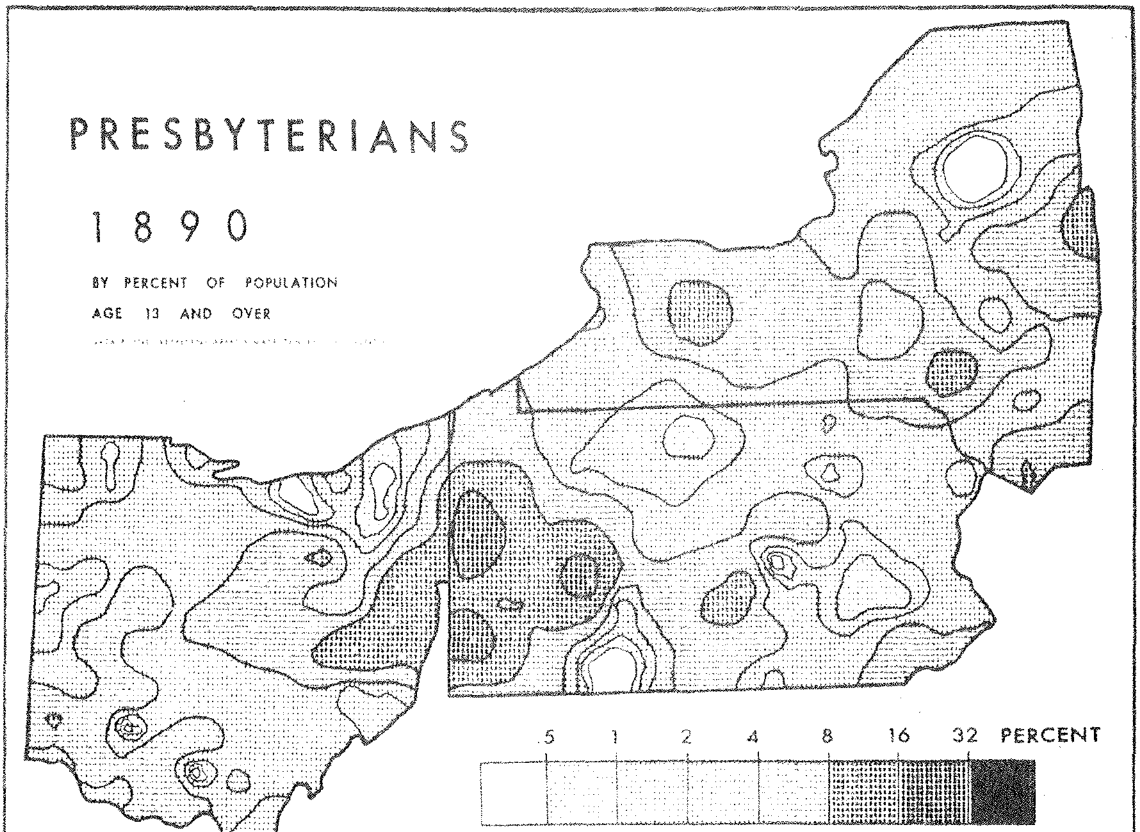

AMERICAN
BAPTISTS
1965
BY PERCENT OF POPULATION
AGE 13 AND OVER
.5 1 2 4 8 16 32 PERCENT

Fig. 4


PRESBYTERIANS
1890
BY PERCENT OF POPULATION
AGE 13 AND OVER
.5
1
2
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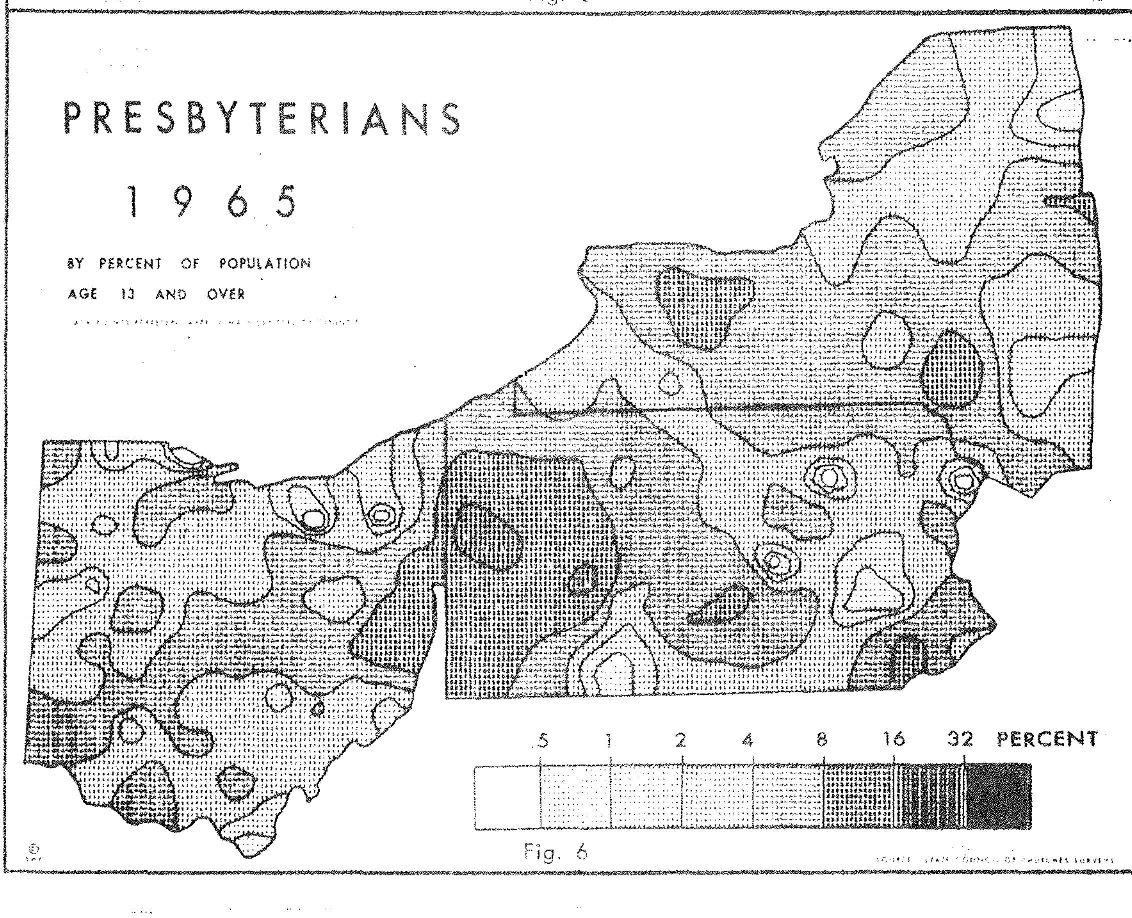
16
32
PERCENT

Fig. 5


PRESBYTERIANS
1965
BY PERCENT OF POPULATION
AGE 13 AND OVER
.5
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8
16
32
PERCENT

Fig. 6

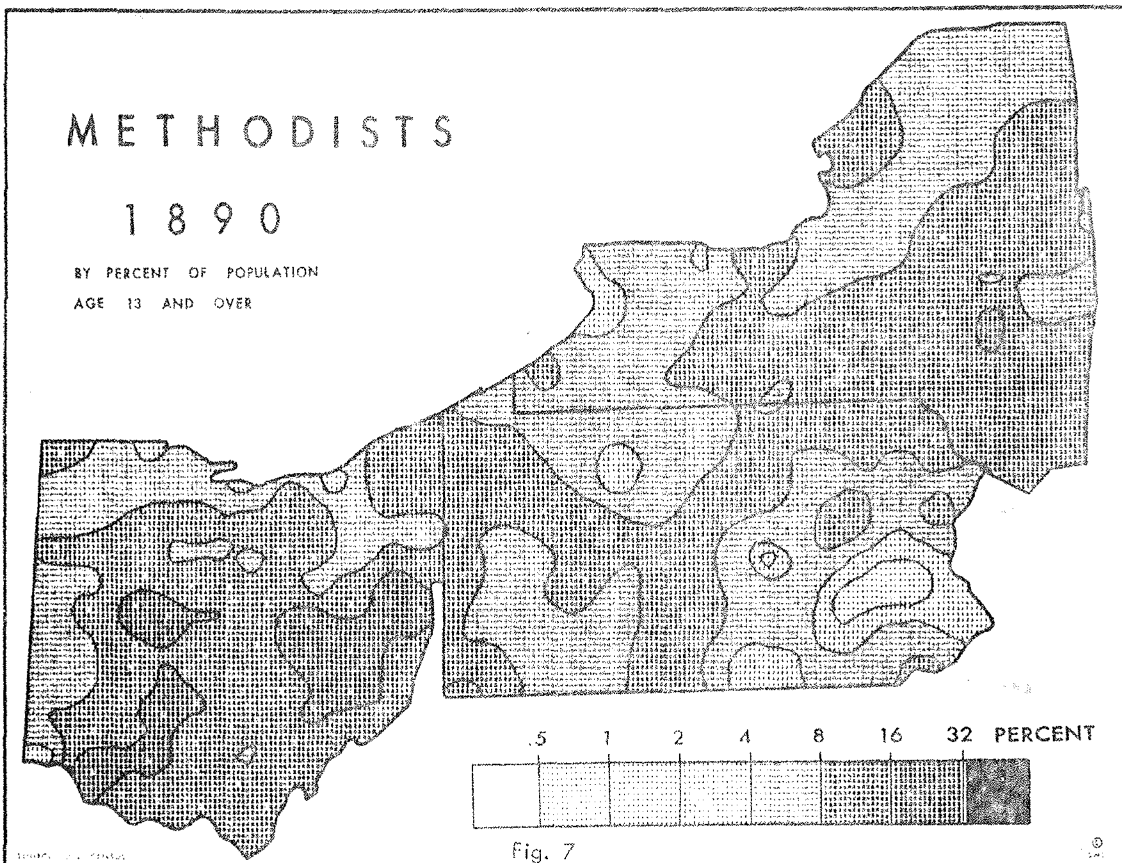
METHODISTS
1890
BY PERCENT OF POPULATION
AGE 13 AND OVER
.5
1
2
4
8
16
32
PERCENT

Fig. 7

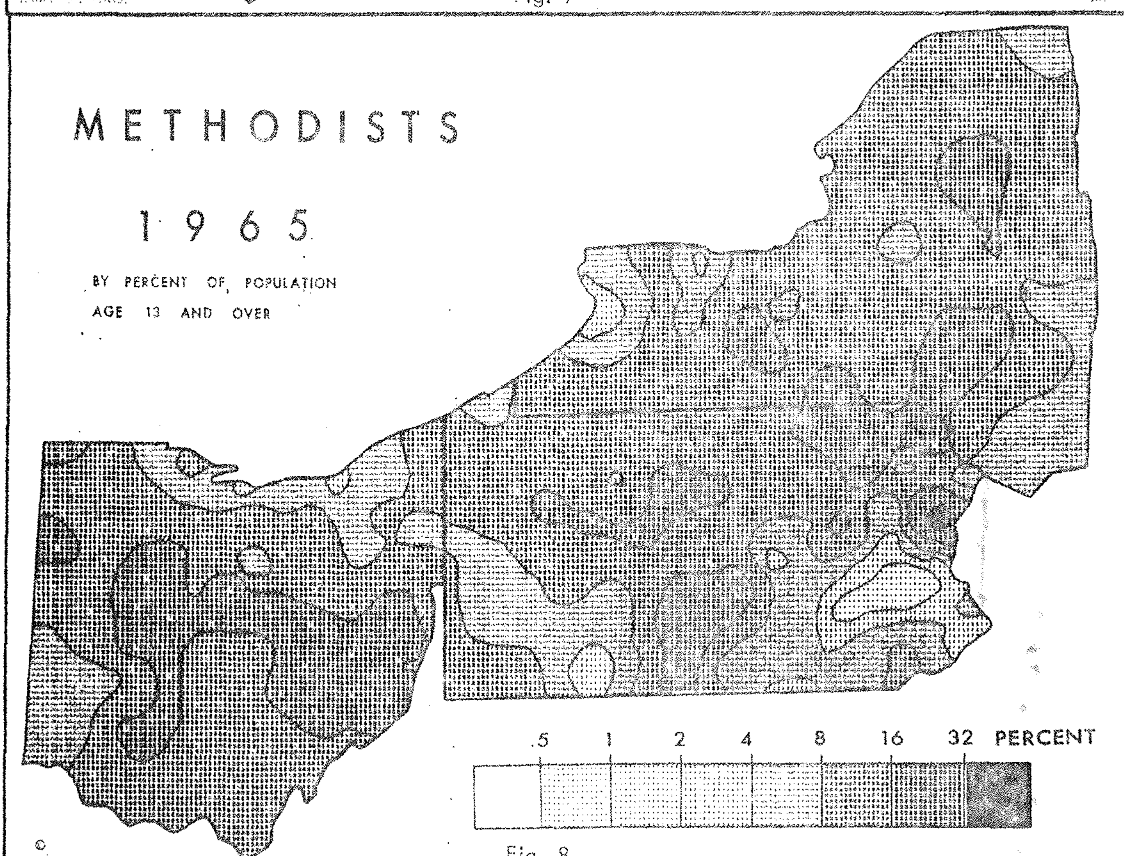
METHODISTS
1965
BY PERCENT OF POPULATION
AGE 13 AND OVER
.5
1
2
4
8
16
32
PERCENT

Fig. 8

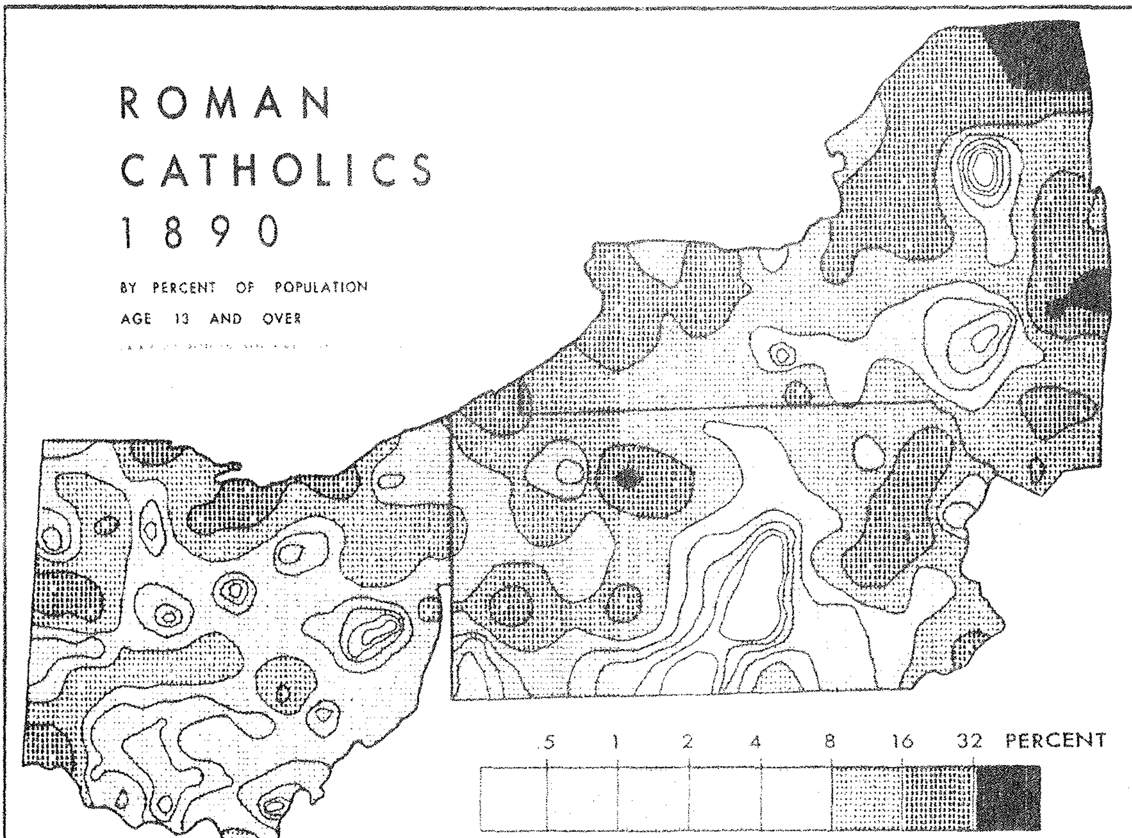
ROMAN
CATHOLICS
1890
BY PERCENT OF POPULATION
AGE 13 AND OVER
.5 1 2 4 8 16 32 PERCENT

Fig. 9

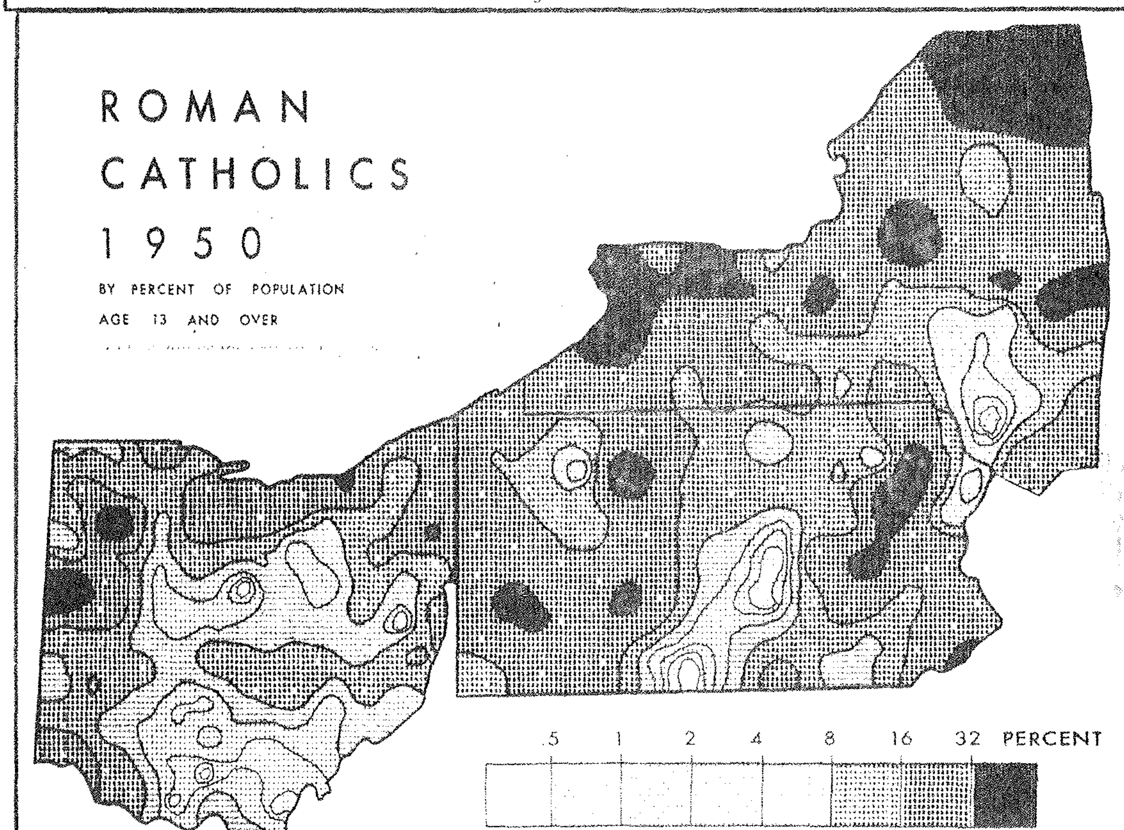
ROMAN
CATHOLICS
1950
BY PERCENT OF POPULATION
AGE 13 AND OVER
.5 1 2 4 8 16 32 PERCENT

Fig. 10

of Albany, through most of southern and western New York, south of the Mohawk corridor, and into northern and northwestern Pennsylvania. A second major area of strength shows up as a curved ridge in central Ohio. Although the general decline is evident in the 1965 map, the 1890 concentrations generally remain as the strongest areas in 1965.

The Presbyterian maps (Figures 5 and 6), in contrast to the previous two groups, present a picture of general stability. In 1890 the Presbyterian "core" is clearly in western Pennsylvania, extending into Ohio. In 1965 the same core area is evident. Another interesting feature of the Presbyterian maps is the presence of stable "peaks" in areas of early Scotch or Scotch-Irish settlement. Washington, Delaware, and Livingston counties in New York, and the peak in south-central Pennsylvania are cases in point.

The Methodist maps (Figures 7 and 8) show overall strength, with the exception of a portion of southeastern Pennsylvania, and several counties containing major urban centers, such as Cleveland, Buffalo, and Rochester. Although the Methodist membership has increased during the period, the percentage of Methodists has remained stable. It is interesting to note that the area of outstanding Methodist strength (over 8%), which in 1890 consisted of most of southern and central Ohio, and southern and eastern New York, connected by a narrow ridge through Pennsylvania, has expanded, by 1965, to include most of northern and central Pennsylvania, and has extended into northern New York and northwestern Ohio. It can also be seen that the proportion of Methodists in the 1890 "core" areas has generally increased by 1965. In 1965, 45 counties had over 16% Methodists, compared with only 18 counties in 1890.

The Roman Catholic maps (Figures 9 and 10) provide an interesting contrast to the Methodist maps. Unfortunately the 1965 figures for Ohio are not yet available, so that the later map is for 1950, but the trend is clear. Roman Catholics have made significant gains both in adult membership and in percentage of adult population during the period. In 1890, Roman Catholics showed their greatest strength in scattered areas, most of which contained a major urban industrial center -- the north country of New York being the outstanding exception. By 1950, it can be seen that these earlier cores have joined into a nearly continuous strip covering most of New York and eastern Pennsylvania, and western Pennsylvania and northern Ohio. The number of counties containing more than 16% Roman Catholics has increased from 43 to 92. As in the case of the Methodists, it can be seen that many of the areas of strength in 1890 have intensified by 1950. Major areas of weakness can be seen in the Catskill-Pocono area of New York and Pennsylvania, in central

Pennsylvania, and in most of southern Ohio. A comparison with the Methodists maps suggests the general rule that strong Methodist areas show up as weak Catholic areas, and vice versa.

In closing, I would like to offer a few general observations. (1) In spite of the reportedly "shaky" statistics, and other questionable methods of my own design, the patterns revealed by the maps are surprisingly consistent, indicating perhaps that religious patterns remain fairly stable, despite other influences. (2) The patterns indicate that both growth, as in the case of the Episcopalians and Roman Catholics, and decline, as in the American Baptist case, tend to appear more as a change in the level of the surface than as a change in the configuration of the surface. (3) Although this paper has barely touched on the topic, it seems evident, at least to the author, that the maps are indicative of generally known historic relationships between settlement patterns and religious affiliations. One may then use them as potential indicators of less well known or recorded features of settlement history. (4) Finally, as a result of the findings thus far, I submit that geographers should not neglect certain sources of social data that lack perfection, especially when the alternative is to do nothing. A careful use of such material, when combined with a powerful tool, like SYMAP, can reveal interesting and important trends, which are difficult, if not impossible, to elucidate by other methods.

Footnotes

[1] Wilbur Zelinsky, "An Approach to the Religious Geography of the United States: Patterns of Church Membership in 1952." Annals, Association of American Geographers, 51 (1961), pp. 139-93.

[2] Ibid., p. 167.

[3] Eleventh Census of the United States: 1890, Vol. 9, Report on Statistics of Churches in the United States, 1894.

[4] Zelinsky, op. cit.

[5] Edwin S. Gaustad, Historical Atlas of Religion in America, (New York: Harper & Row, Publishers, Inc., 1962).

[6] U. S. Bureau of the Census, Religious Bodies: 1916, Part I, Summary and Detailed Tables, pp. 34-40. Religious Bodies: 1926, Vol. I, Summary and Detailed Tables, Table 22, pp. 142-275.

[7] National Council of Churches of Christ in the U. S. A., <u>Churches and Church Membership in the United States: An Enumeration and Analysis by Counties, States, and Regions</u>, Series A, No. 3, p. 1, 1956.

[8] In order to counteract the effect of mergers on the patterns, I have treated each group as if all mergers had occurred prior to 1890. Thus the American Baptist figures for 1890 include some Freewill Baptists in addition to Northern Baptists, Presbyterians include United Presbyterians, Welsh Calvinistic Methodists, and Cumberland Presbyterians in addition to northern Presbyterians, and Methodists consist of Methodist Episcopal and Methodist Protestant Churches.

LOCATIONAL CHARACTERISTICS OF THE PLASTICS INDUSTRY IN THE UNITED STATES

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State University of New York at Buffalo

Introduction

Plastic has become a very important structural material in the United States as well as the rest of the world. The world and United States' consumption, for example, exceeded thirty-three billion pounds and sixteen billion pounds respectively in 1967.[1] There are more than six thousand plastics companies in the United States alone with a combined payroll of approximately one and a half billion dollars.[2] Moreover, the annual growth rate of plastics production averages out to about fourteen percent which corresponds to a doubling of production approximately every five years, as Table 1 illustrates. It has been estimated that plastics consumption will increase eight-hundred percent by 1980.[3] With its present and from all indications, future importance, the study of the plastics industry has been notably lacking in the geographic literature. It is the purpose of this paper to present and analyze the locational characteristics of the plastics industry in the United States and thus help fill that lack. For the most part the analysis will attempt to indicate what appears to be the important locational factors but a precise analysis is not possible due to data limitations.

The General Production Chain

Plastic or more technically, synthetic polymer, is a generalization similar to "wood" or "metal" which refers to a wide variety of structural materials of differing chemical structures and physical properties. In general, plastics are very versatile structural materials which are replacing established materials such as metal, wood, paper and glass. The principal advantages of plastics over other materials are their inexpensiveness, lightness, and the fact that they are easily workable.

The production of a finished product from a particular plastic is, as the case with other structural materials, the end result of a series of manufacturing processes, each one of which having its own distinct orientation. There are, however, certain commonalities in the production processes of all plastics and it may be helpful to observe the general chain of events before analyzing the steps in the production of specific plastics.

The initial step in the production of a plastic is the production of one or more organic chemicals such as ethylene or acetylene. The raw materials are generally petroleum, natural gas, or coal with natural gas being the most important in the United States.

In the second step these organic chemicals are reacted or re-reacted in a series of processes until an organic chemical called a monomer is formed. Monomers may be defined as organic compounds whose molecules have the capability of reacting with themselves and joining together to form larger molecules of increasing molecular weight. The process of molecules joining to form larger molecules is known as polymerization and is usually accompanied by a change in physical state at atmospheric conditions. A liquid or a gaseous monomer, for example, upon polymerization will change state to a solid.

The polymerization of the monomer is the third step in the production process and the output is a plastic material, usually in pellet or powder form, which is ready to be used in the final production steps; i.e., the production of items such as toys, bags, tables, etc.

More than one of the above processes may take place at the same site depending upon the plastic being produced and there are many substages of production into which the preceeding steps could be divided.

Now that the general case has been presented, the production processes of specific plastics will be traced and the factors affecting their location, noted. This paper will deal with only four of the many plastics produced; these are polyethylene, polyvinyl chloride, polystyrene, and polypropylene. The first three plastics account for approximately seventy percent of the total plastic production in the United States and in addition each has a sufficiently large production to provide clear locational patterns. (See Table 2) The fourth plastic, polypropylene, accounts for only four percent of production but has virtually the same locational pattern as polyethylene and it is therefore included.

Polyethylene

Polyethylene is the most important plastic in the United States, accounting for twenty-nine percent of the total plastic output in 1966. (See Table 2.) The major use for this plastic, about forty percent, is for films and sheets which are made into bags and other wrapping materials. Another fifteen percent is used to produce housewares, toys and novelties, twelve percent goes into coating for paper used for such things as milk cartons and about thirteen percent is exported. High density polyethylene, a sturdier variety, is used mainly for making plastic bottles for liquid detergents and bleaches, and for toys.[4,5]

Using the same production chain presented earlier, we note that the first process in the production of polyethylene is the production or acquisition of ethane gas. Although a wide range of raw materials is possible for the production of ethane, it has two major sources in the United States. The primary source, accounting for about seventy-one percent of production, is natural gas, while a secondary source is refinery off gases.[6] The production of ethane is oriented toward the raw material source as can easily be seen by a comparison of Maps 1[7] and 2.[8] Texas and Louisiana are ranked first and second in both the production of natural gas and ethane and natural gas liquids, accounting for sixty-nine percent and sixty-six percent of the total production of the two items respectively. Oklahoma and New Mexico are ranked third and fourth for the production of natural gas and ethane and natural gas liquids but their output is far behind the two leaders.

The location of ethane plants near to the raw material can be accounted for by a combination of factors. One factor is that natural gas contains propane and heavier hydrocarbons which condense in the high-pressure transmission lines, thus retarding the movement of natural gas. For that reason, those items must be removed near the wellhead and plants set up for that purpose are used to extract other items, such as ethane, as well.[9]

Another factor appears to be that the processing of natural gas is most economically carried out in large plants and these have located at the source of the raw material since the many market areas are not large enough individually to warrant a large size plant.[10]

The next step in the production of polyethylene is the production of the <u>monomer</u>, ethylene. Ethylene is an extremely important chemical in the plastics industry as it is not only the monomer for polyethylene but also the starting chemical building block for the other two major plastics to be discussed as well. Ethylene is derived from the ethane gas by the process of dehydrogenation. This process also takes place at the source of the raw material; i.e., the ethane gas. (Compare Maps 2 and 3)[11] Once again it is noted that Texas and Louisiana are the leading states, accounting for more than eighty percent of production. The reason for this orientation is that the raw material, ethane, is a flammable gas and boils at a -88.6° C.[12] With these physical characteristics, the ethane is dangerous and expensive to transport.

The monomer ethylene is also difficult to transport as it too is flammable and boils at a -103.8° C. Thus the production of polyethylene from ethylene monomer takes place at or near the production site for ethylene. A comparison of Maps 3 and 4[13] demonstrates the raw material orientation in the production chain with Texas and Louisiana combining for eighty-three percent of output. The movement of the ethylene is also retarded by the fact that extremely pure ethylene is needed for the production of polyethylene and transportation would thus be even more difficult because of fear of contamination. Since most plastics require ethylene at some stage in their production, it should be noted that the initial steps in the production of the other plastics will be similar to the description above.

The plastic produced in the preceeding step is in pellet or powder form and as such is ready for the final manufacturing stages. The final steps include the changing of the pellet or powder into sheets or plastic film and then the molding, stamping, pressing or cutting of the films or sheets into the desired forms such as housewares or toys. These final steps usually, but not always, take place at the same site. Data on the locations of the final manufacturing step is difficult to acquire as the following quotation from Plastics World indicates.

> "The actual markets for plastics have defied definition for years. We are familiar with the broad market categories that in 1967 accounted for almost 14 billion lb. of plastics - but who are the actual customers? What plants in what industries consume plastics - and to what degree?"[14]

In a recent survey, Plastics World has started to pinpoint the users of plastics but complete results of the findings are not as yet available.[15] Preliminary results, however, show the top twenty-five four digit SIC categories in terms of the use of plastics. (See Table 3.) These industries account for the consumption of approximately sixty-five percent of the plastics output. The leading industry is SIC 3079, Miscellaneous Plastics Products.[16]

A perusal of the list of plastics users gives the impression of an orientation of plastics consumption toward the northeastern part of the United States, but a precise map of consumption is impossible because the amount of plastics consumed by individual industries is not known. Further, even a map of the four digit industries, on the basis of such things as number of employees or value added, is not possible because of discloser laws. To get some notion of the market for plastics, a map of the most important industry, Miscellaneous Plastics Products, is presented. (See Map 5.)[17] The map, as expected, confirms that the Northeastern United States is the primary market for plastics while also showing secondary areas of importance such as California. We thus have all but the final steps in the production chain, for polyethylene, displaying a raw material orientation while the final steps are distinctly market oriented.

Polypropylene

Polypropylene, a plastic which accounts for four percent of the production of the United States, has the same production pattern as polyethylene. This is the result of the fact that the monomer, propylene, is a by-product in the manufacture of ethylene and is thus produced at the same plant site. Propylene, like ethylene, is a flammable gas with a low boiling point and thus difficult to move long distances. Polypropylene is used primarily to produce molded parts for the automotive industry and for the manufacture of synthetic fibers.[18]

Polystyrene

Polystyrene is the second most important plastic in the United States accounting for nineteen percent of the production in 1966. Polystyrene is used primarily for molding objects such as radio and television housings, toys, appliances, and in the production of foam used to make shockproof shipping containers.[19]

The initial steps in the production of polystyrene involves the production of ethane to produce ethylene and the production of benzene. The ethylene and benzene are then reacted to produce ethylbenzene which is then dehydrogenated to produce the monomer, styrene.

The production of the ethylene used in polystyrene follows the same locational pattern as described previously. Moreover, the physical properties of ethylene auger for the reaction of the ethylene and benzene to take place at the site of the production of the ethylene.

This is possible since benzene is produced primarily from petroleum and is thus close to the production sites for ethylene. A map of benzene production exhibits the familiar Gulf Coast orientation. (See Map 6.)[20] The combining of the benzene and ethylene at the production site of the ethylene is facilitated by the fact that benzene is a liquid and although flammable, it has a high boiling point and is easy to transport the short distance necessary. Map 7[21] displays the location of the ethylbenzene production. The ethylbenzene is converted to styrene monomer in captivity on the same plant site. As evidenced in Map 8,[22] Texas and Louisiana are once again the leading states with seventy-eight percent of the United States' production of styrene.

Once the monomer, styrene, has been produced, there is a shift in the production chain away from the raw material source. The production of polystyrene is market orientated with the industrial Northeast accounting for nearly eighty percent of the production. (See Map 9.)[23] A market orientation for the production of the plastic is usually preferred as finished plastics generally have higher freight rates, since they are finished products, and also have a greater bulk than the monomer. However, the physical properties of the monomer, as in the case of ethylene, often makes a market orientation impractical. This is not the case with styrene. Styrene is a liquid with a high boiling point of 145.2°C, and even though it is flammable, can easily be transported in tank cars. The plastic polystyrene is a solid which is shipped in powder form and must therefore be bagged prior to shipping. Further, the reaction to convert styrene to polystyrene proceeds at ninety-five percent yields. Thus the weight loss ratio is virtually zero and the choice involves shipping a liquid or a solid which can be compared with transporting water or snow. Since it would require less space to transport the liquid monomer than the solid plastic, the liquid is shipped to the Northeast, made into the solid plastic and then distributed to the producers of plastic products scattered throughout the region. A comparison of the polystyrene production by state (Map 9) and the map of S.I.C. No. 3079 (Map 5) will confirm the market orientation of the former industry.

Polyvinyl Chloride

Polyvinyl Chloride accounts for approximately eighteen percent of the plastics production in the United States. Its principal uses are for floor covering, phonograph records, toys, garden hoses, clear plastic bottles and automobile upholstery.[24]

The locational pattern of the production of polyvinyl chloride is more complicated than the two previous cases. This arises from the fact that vinyl chloride, the monomer, is produced by two different processes at the same plant site. This is done because one of the reactions yields, as a by-product, one of the raw materials for the other reaction. The two reactions proceed as follows:[25]

(1) Ethylene dichloride + Heat $\longrightarrow$ Vinyl chloride + Hydrochloric Acid

(2) Acetylene + Hydrochloric Acid $\longrightarrow$ Vinyl chloride

From the above chemical formulae it is obvious that ethylene dichloride and acetylene are the major components needed to produce the vinyl chloride. It might be expected, then, that the production of the vinyl chloride may be oriented toward one of these two raw materials or possibly both. We will therefore examine the locational and physical characteristics of the two materials.

Ethylene dichloride is a non-flammable liquid with a boiling point of 83.7° C and therefore it is easily transported. It is formed by the reaction of ethylene and chlorine and is produced near the ethylene plants as evidenced by a comparison of Maps 3 and 10.[26] It should be noted that Texas and Louisiana are leading states and that Kentucky also has a sizable output. The reason for Kentucky's importance will be noted shortly. Once again the orientation of the production is influenced by the physical properties of ethylene cited previously. This of course means that the chlorine must be produced at or near the production site of the ethylene or else transported to it. This is no particular problem as chlorine is produced by the electrolisis of sea water and produced in large quantities in the Gulf Coast area. It is also easily shipped as a non-flammable liquid.

The other chemical of importance in the production of vinyl chloride is acetylene, a flammable gas that boils at -84° C and like ethylene must be used near its point of manufacture. Acetylene is produced by two distinct processes in the United States. One uses coal as the starting material while the other begins with petroleum.

The coal or carbide process which accounts for about fifty-six percent of production begins with the production of calcium carbide by reacting coke and lime in an electric arc furnace. The process requires large amounts of electricity and the product, calcium carbide is a bulky solid which is extremely dangerous to handle since it reacts with water vapor in the atmosphere to form an explosive mixture. Calcium carbide is thus rarely transported but is converted captively to acetylene on the same site. The distribution of coal based acetylene is shown in Map 11.[27] Kentucky is the leading state with about forty percent of total production while Ohio and New York each produce about twenty percent.

Petroleum based acetylene is concentrated along the Gulf Coast chemical complexes with Texas accounting for fifty-nine percent and Louisiana for thirty-one percent of the total production. (See Map 12.)[28]

Thus two different raw materials are used to make vinyl chloride; ethylene dichloride which is easy to transport and acetylene which is difficult to transport. As one would expect the production of vinyl chloride is drawn to the raw material that is the most difficult to move. The areas that produce the acetylene are therefore the areas that produce vinyl chloride. (Compare Maps 11, 12 and 13.)[29] The ratio of acetylene produced in an area is not indicative of the amount of vinyl chloride produced, however. The Gulf Coast is the leading area in vinyl chloride production (about seventy percent of the total) even though it lags slightly behind the combined production of the rest of the states in terms of acetylene production. The Gulf Coast has the advantage of having both the acetylene and vinyl chloride in close proximity. Also petroleum based acetylene is cheaper to produce than the coal based. Coal was once the major source of acetylene but its share of production has been dropping as the petroleum process has become more efficient. The production of vinyl chloride in Kentucky is therefore based to a large extent on that states' production of acetylene.

The plastic, polyvinyl chloride, which is produced by the polymerization of vinyl chloride monomer, is produced according to the pattern exhibited in Map 14.[30] Here again, as with polystyrene, the plastic produced is not located in the region of production of the monomer, but instead is market oriented. The monomer is moved to the market and then polymerized primarily because the plastic is usually handled in powdered form and therefore bulky and expensive to ship. Vinyl chloride is not easy to ship in its natural state as it is a gas that boils at a -13.9°C at atmospheric pressure. The gas is easily compressed into a liquid, however, and the monomer is shipped in that form.

Summary

The easiest way to summarize this paper is to trace the production process for the various plastics in a somewhat abbreviated form. This is done in Table 4. Study of the table will emphasize the raw material orientation in the initial stages of production and a market orientation in the later stages. Only one major difference occurs in the orientation of the location of the various stages for the three major plastics and that is that the polymerization of ethylene monomer is raw material oriented while the polymerization of styrene and vinyl chloride monomers are both market oriented.

One other item bears comment. The maps, due to data availability, are not all for the same year. Although there have doubtless been changes during the time span covered by the maps, they are probably not of sufficient magnitude to drastically alter the basic patterns presented.

Footnotes

[1] "Estimated World Plastics Production, 1966" Plastics, Jan., p. 69.

[2] Courier Express (Buffalo), Feb. 18, 1968.

[3] Ibid.

[4] "Polyethylene Tops 3.5 Billion lb.; Capacity is Strained," Modern Plastics, Jan., 1967, p. 87-88.

[5] "The Plastics Industry in 1966: The Facts and The Figures," Modern Plastics, Jan., 1967, p. 117.

[6] Ethylene Raw Material Pattern to Persist Through 1970, Natural Gas Men Told, Chemical and Engineering News, Oct. 11, 1965, p. 38-39.

[7] Map data computed from: U.S. Bureau of Mines, Minerals Yearbook 1965, Vol II, p. 295.

[8] Map data computed from: U.S. Bureau of Mines, Minerals Yearbook 1965, Vol. II, p. 315.

[9] Essentially this point is made for the production of ethylene to be used in antifreeze in: W. Isard et. al., Methods of Regional Analysis: An Introduction to Regional Science (New York: The Technology Press of the Massachusetts Institute of Technology and John Wiley and Sons, Inc., 1960), pp. 235-240.

[10] Kirk and Othmer, "Gas, Natural," Encyclopedia of Chemical Technology, Vol. 10, p. 454.

[11] Map data computed from: D. P. Burke and R. Miller, "Ethylene," Chemical Week, (Nov. 13, 1965), p. 71.

[12] The various boiling points cited in this paper are from: C. Hodgman, Handbook of Physics and Chemistry (Cleveland: Chemical Rubber Publishing Company, 1962).