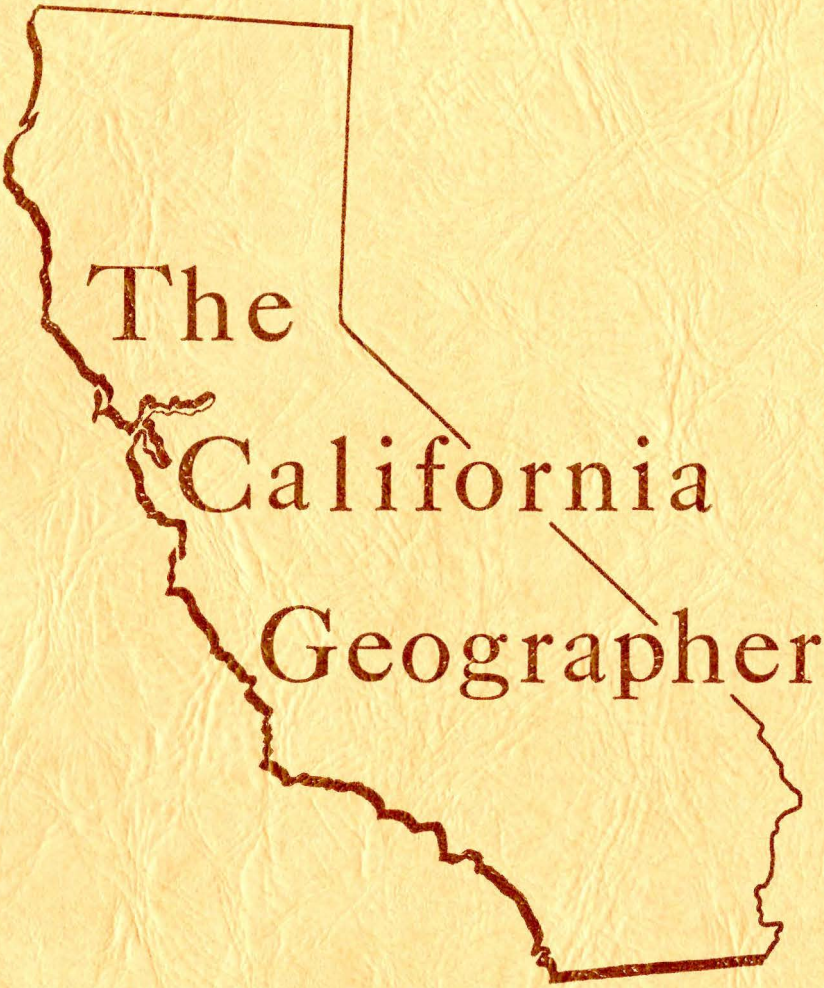

The California Geographer

Annual Publication of the

CALIFORNIA COUNCIL OF GEOGRAPHY TEACHERS

ROBERT A. KENNELLY, *Editor*

1960

THE CALIFORNIA GEOGRAPHER

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Statements and opinions in *The California Geographer* are the responsibility of the authors and do not necessarily reflect the views of the California Council of Geography Teachers.

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Myrta Lisle McClellan

DEDICATION

"The teaching of geography—that is where my heart lay." Thus speaks Miss Myrta Lisle McClellan, Assistant Professor Emeritus of the Geography Department of the University of California at Los Angeles. This first issue of *The California Geographer* is dedicated to her in honor of her life of teaching that has inspired so many others to similar careers.

An interest in teaching preceded Miss McClellan's introduction to Geography, and she took up the profession immediately after graduation from high school in her home town of Winfield, Kansas. It was some years later, while attending the University of Chicago, that a course of lectures by J. Paul Goode proved so stimulating that she knew her destiny was in the field of Geography. Further inspiration came from Rollin D. Salisbury, Ellen Churchill Semple, Wallace W. Atwood, and, in the School of Education, Zonia Baber.

The first opportunity to teach in her chosen subject came at the University High School where she taught physiography for two years. After receiving her Bachelor of Science degree from the University in 1912, she became a member of the Geography Department of the Illinois State Normal University at Normal, Illinois. The following year James F. Chamberlain, Head of the Geography Department of Los Angeles State Normal School, requested that she join his staff. She did so in 1913, following the school from its downtown site on Fifth Street to the Vermont Avenue campus in 1914, and in 1929 to the present Westwood campus of U.C.L.A. where she remained until retirement in 1941.

Her undying enthusiasm amounted to a missionary's zeal when it came to revealing the values of Geography to her students, or, as she often worded it, "teaching them to geographize'." Her greatest source of satisfaction has been the contributions to Geography made by these students who have gone out from the University to enlarge and expand the field. We of the California Council are grateful for the early and continuing inspiration of Miss McClellan.

—Glenn Cunningham.

VENEZUELA MOVES ONTO THE WORLD'S IRON ORE MAP

C. Langdon White
Stanford University

A decade ago Venezuela was not even on the map of the world's ore-producing countries. By 1959, however, it was producing and exporting almost 15 million tons, and it possessed estimated reserves of 2 billion tons.[1] Today Venezuela is Latin America's largest exporter of iron ore and, though its total estimated reserves are much smaller than those of Brazil, it is Venezuela, not Brazil, that holds the greatest promise as a future producer and exporter.

The value of the iron ore to Venezuela positively cannot be overestimated, for the country has long been a victim of monoculture: in fact, not one of the 20 countries comprising Latin America, where monoculture is most serious, is so dependent upon a single product for its economic life as is Venezuela upon petroleum. Oil provides about 90 per cent of the exports by value and about 92 per cent of the foreign exchange; it is roughly the source of one-half the national budget. Iron ore gives Venezuela an additional important raw material.

Discovery and Development of Iron Ore

Iron ore was first discovered in the Orinoco Basin in 1926 when a native prospector stood atop a mountain known as El Florero (now the El Pao mine) and excitedly announced that he had found a large, rich, new source of iron ore. However, this discovery did not electrify the world. There was plenty of iron ore at the time which was much better located with respect to the world's important iron and steel manufacturing regions. Moreover, Venezula had no iron and steel industry and gave little promise of having one for a long time (even in 1957 domestic consumption accounted for only 6,146 tons of iron ore). At the time of discovery in Venezuela, the American iron and steel industry rested on a solid foundation of Lake Superior ore.

Venezuela leaped onto the world iron ore map following the startling statement of an outstanding steel executive at the close of World War II that that war was the last which would be fought from the Mesabi Range. What he meant was that in two world wars, the United States had drawn so heavily upon the iron ores of the Lake Superior Region, and particularly of the Mesabi Range, that most of the high-grade ore had already been mined. When those enormous deposits were discovered more than a half century ago, they were the world's largest and it was believed that they were virtually inexhaustible: certainly it seemed that they would last the United States for centuries. What no one realized then was the phenomenal growth that the American iron and steel industry would chalk up (in 1956 the United States used 133 million tons of iron ore). Since 1900 the Lake Superior Region has supplied about 80 per cent of the domestic iron ore.

[1] U.S. Bureau of Mines, *Mineral Trade Notes*, XLVII (August, 1958) p. 11.

The large iron and steel companies and ore companies plan 50 or even 100 years ahead (with an investment exceeding $5 billion, they cannot operate on a hand-to-mouth basis). Hence with dwindling deposits at home, the companies sent geologists and mining engineers into all parts of the world seeking new deposits.[2] After examining hundreds of areas, they concentrated on Canada, Liberia, Peru, and Venezula.

The executives were well aware, however, that any nation that makes as much steel as the United States (113 million net tons in 1957, or 35 per cent of the world's total, contrasted with 57 million net tons for the Soviet Union, second largest producer) ought not to depend on distant lands for the greater portion of a natural resource employed in such enormous quantities as is iron ore and used to make the most widely adopted of all metals (American production of steel is 100 times that of copper, the second metal, and 20 times that of all other metals combined). Enemy submarines could exact a terrible toll as they did during World War II. Thus from the standpoint of national defense, full dependence on foreign ore is too dangerous. Yet foreign sources of ore should be developed by American companies to prolong in peacetime the life of the richer deposits in the Lake Superior Region. To lessen such dependence upon foreign ore, American companies invested almost $1 billion on research and development of taconite, billions of tons of which lie in the Lake Superior Region. Taconite is low grade ore: it is about the hardest toughest rock known. The metallic iron is scattered through the rock in tiny particles, some so fine they can be concealed under a single grain of face powder.The problem was to separate those particles of iron from the rock and bundle them together by the millions into solid pellets that could be charged into blast furnaces. Obviously this entire operation is difficult and costly.[3] The research however, has paid off and taconite (about 8 million tons in 1958) is now moving down the lakes, though in small quantity compared with the tonnage of better ore from that region or even with that of foreign ore.

In 1958 the United States imported 31 million tons of iron ore, the contributing countries being Venezuela, Canada, Chile, and Peru, in this order.

Venezuela's New El Dorado—Iron Ore

Venezuela's iron ore reserves are estimated at 2 billion tons. There is little doubt that this figure is too conservative. All the commercial ore is to be found in the northern part of the Guiana Highland Region south of the Orinoco. All the ore is now in a National Reserve — even the deposits held by foreign companies. However, in 1959 the Venezuelan government created a new 30-mile-wide national mineral reserve strip along the Orinoco from Tucupita, Delta Amacuro Territory, to the Rio Meta, on the border with Colombia. This strip it will be noted, lies north of the

[2] Actually, iron ore is not a scarce mineral. Large deposits are scattered throughout the world. See Mikami, Harry M., "World Iron Ore Map," *Economic Geology,* XXXIX (January-February, 1944), pp. 1-24.

[3] An excellent *brief* treatment of taconite and the problems involved in its recovery by George Eckel appeared in the *New York Times,* January 3, 1951.

Orinoco. The purpose of this move appears to be to assure Venezuela that she reaps full economic advantage from the national heritage.[4]

Venezuela ore now and in the future seems destined for export. Though the government is constructing a national iron and steel plant near Puerto Ordaz, the mills will be unable to use more than a trickle of the country's ore output, for Venezuela had a population of only 5,034, 838 in 1950 and 6,439,165 (estimated) in 1957. Aside from the petroleum industry, the nation uses very little steel.

As of 1959, exploitation is confined solely to El Pao and Cerro Bolívar, both in the State of Bolívar (Fig. 1).

One problem common to both mining ventures has to do with the rise and fall of the water level in the Orinoco – the level varying up to 42.7 feet. Obviously this initially posed a real problem for ore handling.

El Pao. El Pao, the iron mine of Bethlehem Steel Corporation, lies about 36 miles south of the port of Palua on the right bank of the Caroní just where it debouches into the Orinoco (Fig. 1). This deposit of ore

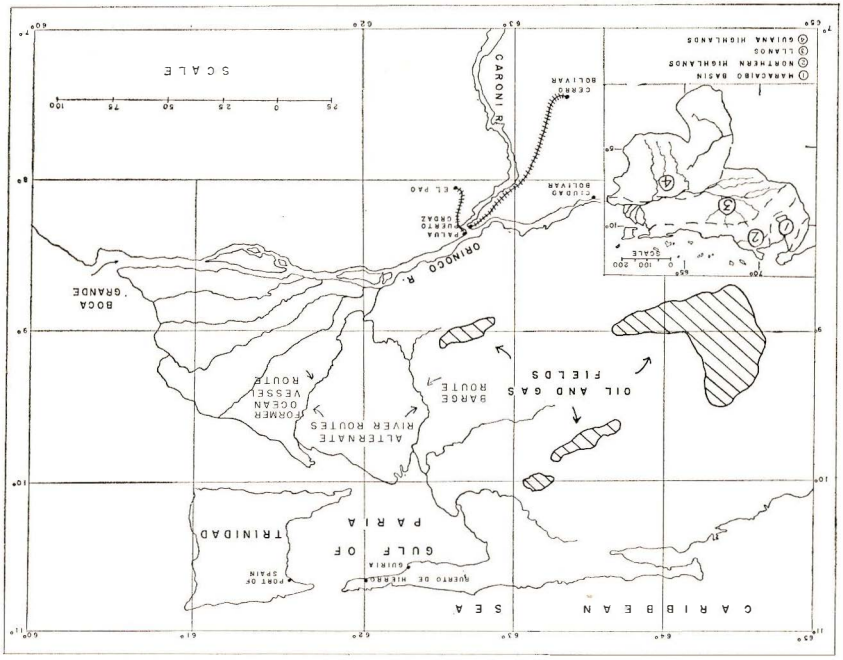

Fig. 1. Venezuela's geographic regions and iron ore complex. In the northern Guiana Highland Region is one of the largest, richest (metallic content of ore), and most accessible iron ore areas in the world.

was discovered by a native Venezuelan in 1926 but did not receive serious study until the 1930's. Development was delayed until 1950 because of the war. Bethlehem acquired concessions to 22 ore bodies but

[4] *Hispanic American Report,* XII (September 1959), p. 388.

relinquished six. The remaining 16 include a total area of about 20,000 acres. It is significant that the mining rights east of the Caroní are limited to 40 years, whereas those on the west side extend to 100 years. The reason for this is that the ore on the east side was known some years before ore was even discovered on the west side.

Reserves at El Pao are placed at 100 million tons of ore running 61.55 to 65.0 per cent metallic iron. The main deposit which is bowl-shaped, is about 2,600 feet long and 1,700 feet wide and lies atop a hill that rises several hundred feet above the surrounding area. The ore body varies in thickness from a few feet to 400 feet, with an overburden of some 425 feet.

The method of mining is called the open pit but actually it is not: it is open pit in reverse and should be called strip mining. In this method ore is sliced off the top of the hill in benches of about 42 feet. The ore is picked up by power shovel and dropped into trucks which deliver it to a crusher located about a mile from the mine, whence it travels by rubber conveyor to a secondary crusher and again by belt conveyor to an ore-loading bench on the company-owned railroad. The ore then moves to Palua in trains of 30 to 33 cars, each car holding 70 tons. At Palua there is a stockpile capable of holding 800,000 tons of ore. At the outset, the ore was shipped either by barge or small river boats, depending upon whether it was the high- or low-water season. The barges traveled via the Cano Manamo (230 miles), the vessels with their greater draft through the main channel of Orinoco—the Boca Grande (395 miles). Both conveyances carried the ore to Puerto de Hierro on the southern shore of the Paria Peninsula. Here the ore was transferred to a stockpile, capable of holding 1,250,000 tons, preparatory to loading into specially designed ore-carrying vessels destined for Sparrows Point, Maryland. Today no barges are being used and all the ore goes to Puerto de Hierro via the Boca Grande.

When El Pao is fully developed, it will send 3 million tons of iron ore a year to the United States.

Cerro Bolívar. This great hill is 7½ miles long, 2½ miles wide, and 1,800 feet above the surrounding landscape. The ore body is four miles long with a maximum width of 4,000 feet. Average ore thickness is 230 feet, maximum proven thickness 585 feet. The ore is free of overburden. Standing in the northern Guiana Highland Region (Fig. 1,) the hill is regarded as the greatest iron ore discovery since the Mesabi Range in the Lake Superior Region. It is believed that Cerro Bolívar will equal, perhaps surpass, in tonnage the world-famous Hull-Rust Mine in the Mesabi. It will certainly surpass it in richness of the ore. The reserve is placed at a half billion tons.

Lying in a hitherto unexplored part of Venezuela, it was discovered in 1947 during the United States Steel Corporation's world-wide search States Army and the Venezulan government during World War II gave some indication of a considerable outcrop of ore. The Steel Corporation then made a detailed aerial survey of the same area. Exploration by jeep and on foot followed. Magnetometer surveys left no doubt regarding the

presence of ore. Diamond drills were then put into operation to test the size of the deposit and an exploration tunnel was driven into the side of Cerro Bolívar. United States Steel's mining rights were for 100 years, because at the time it acquired them, the iron ore on the west side of the Caroní was yet undiscovered.

Cerro Bolívar lies about 90 miles south of the confluence of the Caroní and the Orinoco on the west or left side of the Caroní (Fig. 1). The mountain is capped with iron ore, a mixture of hematite, limonite, and magnetite, practically free from objectionable elements. The metallic content varies from 58 to 61.50 per cent. The ore is minable by blasting and with power shovels, and the top of the mountain is being sliced off in horizontal cuts of 35 to 50 feet. The shovels drop the ore into trucks which haul it downhill to loading ramps where it is dumped into hopper cars on the railroad. It is then hauled in trains of 125 cars of 90 tons each (five trains per day) to Puerto Ordaz (fig. 1), where it is crushed twice enroute to a storage yard having a capacity of more than 1,300,000 tons. From storage the ore travels by belt conveyor to the vessel holds at a rate of 100 tons per minute. Unlike the situation at Palua, these are ocean-going ships. In order for vessels capable of carrying 30,000 to 60,000 tons of ore to ascend the river for 178 miles, the Steel Corporation decided to dredge the lower Orinoco and the Orinoco's largest delta channel—the Caño Macareo, as this seemed most immediately feasible from an engineering and economic viewpoint. The Corporation preferred to use ocean-going ships on the Orinoco in order to eliminate construction of a transfer point at the mouth. This, of course, necessitated costly and time-consuming dredging.[5] Maintenance of the Caño Macareo route proved to be costly beyond all estimates and navigation was limited to daylight hours. Accordingly the company made studies seeking an improved route. The Boca Grande is the route now used (Fig. 1.) It can accommodate large vessels drawing 30 feet of water that carry 40,000 tons of ore.[6] This ore moves to Morrisville, Pennsylvania, where it is used at the Fairless Works, and to Mobile, from where it is sent to Birmingham for "sweetening" the low-grade Alabama ores.

Summary and Conclusions

The development of Venezuela's iron ore deposits is signaling a new era in the economic life of the country whose chief export for about 50 years has been petroleum. It is dangerous for any nation to depend overwhelmingly on a single commodity—particularly one that is so expendable as oil, one whose markets lie outside the country, and one whose price is determined on the international market.

All the mining to date being carried on by American corporations, though a Venezuelan company is soon to get under way. As an international producer of iron ore, Venezuela promises to have a very bright future, the following factors appearing favorable:

(1) Proved reserves of at least 2 billion tons.

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[5] Gahagan, Walter H., "Memorable Dredging Operation Opens Orinoco-Macareo Waterway," *Civil Engineering*, XXIII (December, 1953), pp. 816-820.

[6] Laird, O. B., Steel Corporation, personal comunication, October 9, 1959.

(2) Ore of exceptionally high quality—58 to 65 per cent iron.

(3) Access by large ocean-going vessels into the heart of the country as a result of dredging of the Orinoco by the United States Steel Corporation.

(4) Powerful steel corporations of the United States in need of high-grade ore and with ample financial reserves to exploit it.

(5) Large world markets available because the reserves of high-grade ore in all the major iron and steel manufacturing countries are rapidly dwindling.

(6) An ample supply of labor.

(7) Tropical climate which permits year-round mining.

(8) All signs pointing to a phenomenal increase in iron and steel-making in the years ahead in all parts of the world.

(9) Venezuela's probable ability to compete in world markets because of the huge reserves, the high quality of the ore, the modern methods of mining, and water transportation.

(10) An investment climate in Venezuela which has for years been the best in all Latin America for foreign capital.[7]

[7] In 1958 the Provisional Government introduced some changes in the Income Tax Law that shook this confidence. *The main change applied to the surtax. For a* discussion of this tax see "Income Tax Rates Slightly Raised in Venezuela," *Venezuela Up-to-Date, IX* (*February,* 1959), p. 5.

THE COUNTY ATLAS OF THE UNITED STATES

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University of California, Los Angeles

The privately-produced county atlas is an American phenomenon. Since the appearance of the first of these volumes about a century ago, well over four thousand different atlases and plat books of United States counties have been published by private companies and individuals. County atlases and plat books are considered together in this study since there are essential similarities between these two cartographic products; the terms are used interchangeably by some publishers. The core of both the county atlas and the county plat book usually consists of cadastral maps of each civil township in a particular county. Roads and railroads in addition to property lines, the names of property owners and areas of individual land holdings commonly appear on the maps. Although this is usually the basic information contained in county atlases and plat books, depending upon the publisher and the date of publication, there is a great deal of variation in the format. Some of these atlases are handsomely bound and contain engraved maps and township plats, considerable textual material and lithographic illustrations. At the other end of the scale county atlases or plat books may consist of a series of blueprint copies of plats, or simply street plans in urban areas, between simple paper covers. Some county atlases were hastily compiled with the object of realizing a quick profit for the publisher, while others are very accurate and reliable records.

A number of atlases of United States counties have been published by federal and local government agencies. Although such atlases account for considerable cadastral map coverage in a few states, they do not form a large component of the total United States county atlas output. Such government-sponsored atlases are not considered in this article, nor are official or unofficial cadastral maps and atlases of minor civil divisions, which are often the most important source materials used by the compilers of privately produced county atlases, and plat books. Only atlases which cover all or a large part of any particular United States county and which have been compiled, printed and published by private enterprise are included. Emphasis is placed on the earlier county atlas, which is described in greater detail than the more familiar modern plat book.

DEVELOPMENT

Individual map sheets of regions, states and localities were published in America in colonial times. The production of general atlases in the United States, which dates from the last years of the eighteenth century, increased notably in the early nineteenth century, when the state atlas was introduced. During the first half of the last century a steadily growing number of cadastral maps of townships were made of the more populous areas of the north Atlantic states. At first, such maps were usually hand drawn originals commissioned by township officials. Boundaries, survey lines, roads and prominent physical features, particularly streams, are delineated on such maps. The perambulator-type odometer and the magnetic compass were the principle surveying instruments used for the field work which preceded compilation and drafting.

A demand among local landowners for these township maps led to production of engraved editions. By the middle of the last century privately-published cadastral maps, not only of townships, but also of entire counties, were fairly common. Since these county maps were often drawn on a scale of one inch to one mile or larger, they were cumbersome and easily damaged. The introduction of the county atlas, which is charateristically a volume of township plats, was an answer to problems of size, storage and preservation.

Although the first United States county maps and atlases were produced in the middle and north Atlantic states, especially Pennsylvania and New York, and depicted counties in those states, it is in the Middle West that the private county map and atlas business has had its greatest success. Following the Civil War a number of ex-army officers saw the commercial possibilities of producing cadastral atlases of the prosperous agricultural counties of this more recently settled region.

Preparation of cadastral maps of the prevailingly plains-like Midwest proved to be a simpler operation than it was in the counties of the northeast, where local relief and slope are commonly greater. Moreover, the basic method of land subdivision used in the Atlantic states is the unsystematic metes and bounds survey; in this type of cadastral survey boundary lines, which are often ill-defined, extend in any and all directions. Property mapping is admittedly more difficult in areas subdivided in this manner than in the Middle West, where the systematic, rectangular method of the United States Land System was employed. Under this survey regularly-spaced lines oriented in cardinal directions enclose the well-known mile-square sections; most of the farm holdings are simple proportions of the section, with boundaries commonly parallel to the fundamental survey lines. (Fig. 1)

A description of methods used in the county atlas business in the formative period is contained in a contemporary account by a critic of these methods, Bates Harrington.[1] According to this observer, the county atlas business grew out of earlier township and county map enterprises. County maps which were often financed on a subscription basis sold for about five dollars each in the mid-nineteenth century. The earliest examples are rather simple but later ones are frequently adorned around the edges with pictures of the establishments of prominent citizens. For the privilege of having such a picture on the map, the landowner would pay approximately thirty dollars. This proved to be a lucrative proposition to map publishers who wished to increase their incomes with additional pictures. However, there is a limit to the number of illustrations that can be conveniently placed around a map. An atlas enabled the publisher to increase greatly the amount of space available for pictures and maps and also permitted the introduction of pages of text.

County atlases, like the earlier county maps, were usually produced on a subscription basis. An agent of the atlas company would go to a county to attempt to interest the wealthiest and most influential men in

[1]B. Harrington, "How 'tis Done": A Thorough Ventilation of the Numerous Schemes Conducted by Wandering Canvassers." (Chicago, 1879).

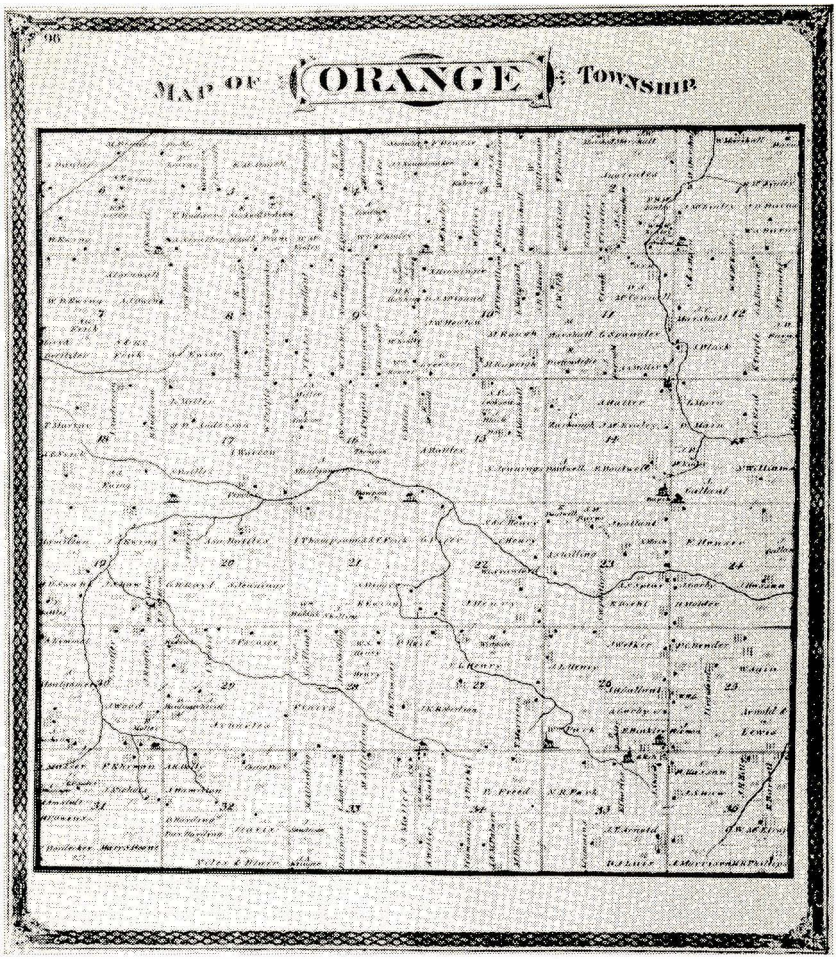

Fig. 1. Township plat from "Atlas of Union County," (Ohio) by A.S. Mowry published in Philadelphia in 1877. This map, the original of which is on a scale of approximately 2 inches to the mile and occupies one page in the atlas, is a representative example of county atlas cartography.

the atlas project. He would interview local officials, lawyers, business men—especially realtors—as well as large landowners. Sometimes the canvasser succeeded in obtaining official sponsorship of the county board of supervisors and often a notice of the projected atlas would appear in the local newspaper together with a list of the sponsors. Canvassers would then go into the rural areas to sell subscriptions to farmers; each subscriber was required to sign a contract for the atlas, delivery being promised for several months later. A list of all the subscribers appears in many county atlases. The usual price for a single atlas subscription in the late nineteeth century was approximately ten dollars.

Another agent of the publishing company would contact the wealthier men of the county relative to having pictures of themselves, their families or their property included in the atlas. If an individual was agreeable to this proposal, he was required to sign a contract and later an artist would call to make sketches under the patron's direction. Such sketches were the basis for the illustrations which appear in large numbers in some of the atlases. The cost of such a picture was usually not less than fifty dollars and might be several times this figure, depending upon the subject and the amount of space occupied. (Fig. 2)

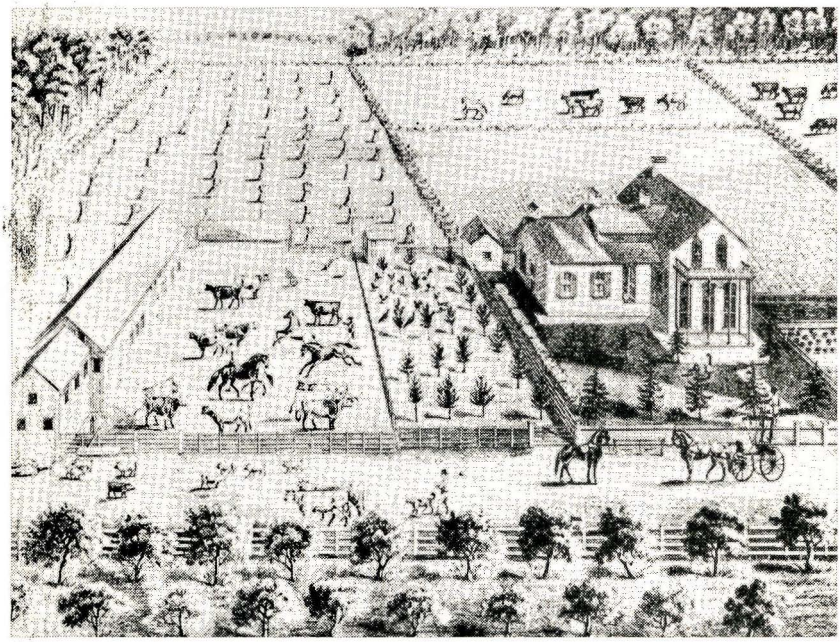

Fig. 2. A lithographic illustration from "Illustrated Atlas of Hancock County, Ohio," by G. A. Eberhart, published in Chicago in 1875. Views of this kind, although of little artistic merit, provide valuable information on the contemporary rural landscape.

Biographies of local persons are a feature of many of the atlases. Yet another agent of the publisher would be sent to the prospective client to discuss the matter of a biography. If a canvasser succeeded in selling this service another contract was signed, after which the agent would read a list of form questions to the patron and his family. From the responses to these questions an account of the life of the individual was composed; the price for a biography was usually two and a half cents a word with a minimum of ten dollars. Techniques employed in the county atlas business were well-tried methods of salesmanship: the product was identified with established institutions, the client committed himself a little at a time and payment was deferred.

The amount realized from the sale of a county atlas in the eighteen seventies appears to have averaged about twenty-five thousand dollars per

edition.[2] The total cost to the publisher was often about half this figure, while the remainder was clear profit. In view of this it is not surprising that substantial fortunes were amassed by some publishers. Usually the production of the original maps was one of the least considerable expenses, amounting to only a few hundred dollars per atlas. Information on property boundaries, size of properties and ownership was either copied from official cadastral maps or compiled from tax lists, and other records. When a draft of a civil division had been prepared by the agent of an atlas company, he would drive around the township in a buggy to add other information to the map. He would sketch in features such as roads, railroads, houses, farmsteads, churches, schools, blacksmiths' shops, orchards, timber lands, quarries, coal lands, etc. Detailed information on springs and wells derived from personal interviews with local residents, but the field work for an entire township might take only a few days. The major expenditures in the county atlas business were in printing, binding and selling the product, not in compiling the data.

The publishers of county atlases concentrated their efforts on counties considered to have sufficient numbers of landowners to support this kind of enterprise. A predominantly rural county with a population in excess of ten thousand persons was regarded by atlas publishers as a good prospect. In a county with a population of twenty thousand, an average of one thousand atlases might be sold. While many landowners refused to subscribe to the work, others would buy several copies. There is a record of one patron who purchased nineteen copies of an atlas for a total of one hundred and seventeen dollars; the same individual ordered a page view of his establishment at a cost of one hundred and sixty dollars and also contracted for a portrait and biography at three hundred and sixty-five dollars, making a grand total of six hundred and forty-two dollars. [3]

The most elaborate and expensive county atlases contain maps of the world and of various states. They also include short historical accounts of the development of the United States, of the county and of each township in the county, in addition to the usual maps, biographies, illustrations, and subscription lists.

Coverage and Place of Publication

Over two hundred cities and towns in the United States can claim to be the place of publication of at least one county atlas or plat book. However, most of these atlases have been produced in a few centers by a comparativly modest number of publishing houses.

Apparently the earliest United States county atlases were of certain counties in Pennsylvania and were published in Philadelphia in the early 1860's.[4] Toward the end of this decade New York City became, briefly, the leading publishing center for county atlases. During the period 1860 to 1869 atlases appeared of a number of counties in New York State and

[2] Ibid. pp. 74 and 75. The estimated sales of fourteen county atlases sold in fourteen differenent Illinois counties averaged approximately $25,000 but ranged from $17,000 to $38,000 per atlas. The atlases in question, which are all dated between 1870 and 1876, include the work of several different publishers.

[3] Ibid. p. 93.

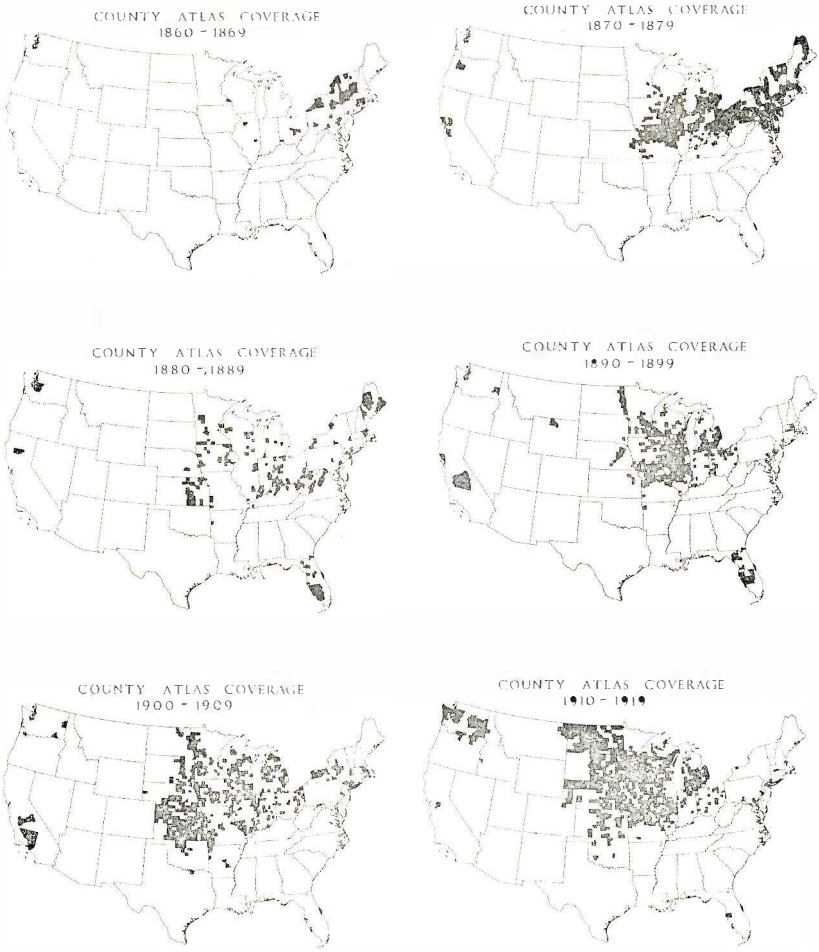

Fig. 3. The dark areas on the maps indicate the coverage of privately-produced county atlases and plat books between the given dates only. Atlases not positively dated are excluded.

New England as well as Pennsylvania and also a few scattered areas in the Middle West. (Fig. 3).

In the next decade, 1870 to 1879, Philadelphia assumed undisputed leadership as the place of publication of county atlases with Chicago and New York as the next most important centers. At this period atlases were

[4] C. Le Gear, "United States Atlases, A List of National, State, County, City and Regional Alases in the Library of Congress," (Washington 1950), p. III and C. Le Gear, "United States Atlases, A Catalog of National, State, County and Regional Atlases in the Library of Congress and Cooperating Libraries," volume 2 (Washington, 1953), p. III. These volumes were principal source materials used for the compilation of the maps, Figures 3, 4, and 5 of this study.

produced for numbers of counties in the Atlantic states north of Washington, D. C., particularly those counties not covered in the previous decade. The Middle West became the most important market for the commercial county atlas at this time; most Ohio counties could boast of having an atlas by 1879, but no great publishing center developed in the state. Ohio county atlases of the time were produced mainly in Philadelphia, and later, in Chicago. Other significant publishing centers for county atlases at this period include Davenport, Iowa, St. Louis, Missouri, and San Francisco. Almost all the atlases produced in the last-named city were of counties in Central California.

During most years of the 1880's county atlas production in Philadelphia exceed that of Chicago, the second ranking center. New York City declined markedly as a place of publication for these volumes during the decade, while Minneapolis became increasingly significant. There appears to have been a temporary decline in the total number of atlases produced during the decade, but again the Middle West was the leading market area. An expansion took place into regions peripheral to the area covered in the previous decade. Atlases were prepared covering a condsiderable number of counties in Kansas, West Virginia, Kentucky and Maine. During the decade several counties in Florida were mapped; most of the county atlases for this state, produced in the 1880's and 1890's were published by a railroad company in Buffalo, New York.

After 1890 the Middle West became more emphatically the principal market area for county atlases than it had been in the preceding two decades. (Fig. 4). Chicago, at the time, was clearly the leading place of publication of the county atlas. During the decade 1890 to 1899 about twice

COUNTY ATLAS COVERAGE
1860 to 1950

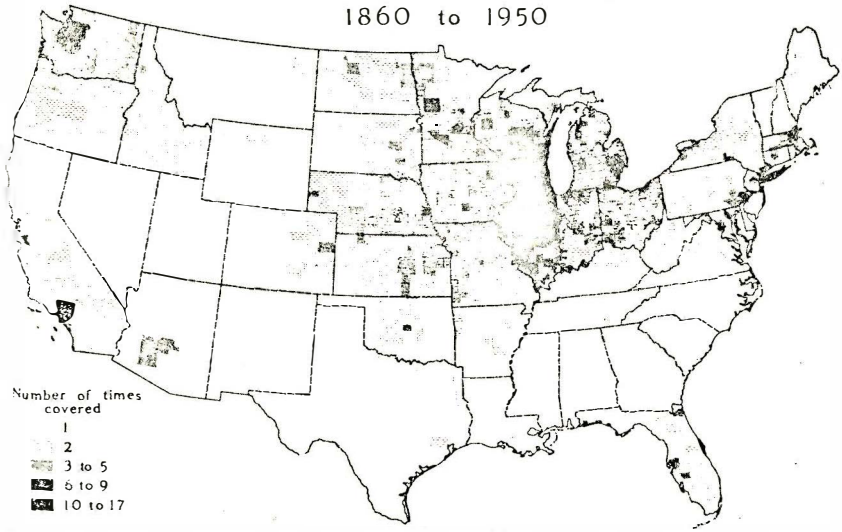

Fig. 4. The symbols indicate the exent and frequency of coverage by privately-produced county atlases and plat books, both dated and undated. Post-1950 coverage is concentrated mainly in areas previously covered, particularly counties in Iowa and Minnesota.

as many such atlases were published in Chicago as in Philadelphia, the next most important center. The third center, in terms of the number of atlases published at this period, was the Twin City area of Minneapolis and Saint Paul.

These trends continued in the first decade of the present century, when approximately half of all the county atlases published in the United States originated in Chicago. The second most significant center at this time was the Minneapolis-St. Paul area. Philadelphia, following the example of New York City, dwindled in importance; only half as many county atlases were published in this eastern city, during the decade 1900 to 1909 as were produced in the Twin Cities. County atlases originating from big and small Middle Western centers accounted for considerable map coverage, particularly in the Great Lakes region and the central Great Plains.

Chicago maintained its position as the leading center of publication for county atlases during the next decade, 1910 to 1919, but it was seriously challenged by another northern Illinois city, Rockford. Philadelphia and New York were eclipsed by Minneapolis and Saint Paul and also by certain Iowa centers, especially Mason City and Des Moines. The publishers of county atlases and plat books were particularly active developing a market in the Dakotas, Nebraska, Kansas and Minnesota. Some counties in the heart of the Corn Belt were being canvassed for the third or fourth time. After the appearance of a particular county atlas it was usual for publishers to wait from five to ten years before covering the territory again.

About the time of World I the elaborate county atlas gave way to the simpler and less expensive plat book. At this period a number of industries and enterprises moved from Chicago into the Rock River Valley; this shift is evident in the county atlas and plat book business. The center of plat book publication in the United States at present is Rockford, Illinois; several firms have their headquarters in this city. Unfortunately, the date of publication is not given on the plat books produced by some of the largest publishers, which makes these documents much less valuable than they would be if dated. Modern plat books may cost as little as one dollar, and it is not usual for them to be produced on a subscription basis. The present-day plat book consists, typically, of paper bound volume of township maps. On these maps the names of landowners, sizes of properties and the limits of land holdings are indicated; towns, roads and also streams are shown. Characteristically, a county index map is included and, quite frequently, a photograph of the county courthouse appears on the cover. However, modern plat books usually lack much of the cultural data which makes older county atlases such interesting documents.

The total coverage of commercially-produced county atlases and plat books from 1860 to 1950 is shown approximately on the map, Figure 5. The number of times particular areas have been covered by different county atlases or separate editions of the same atlas is indicated by shading. Perhaps the most striking feature of the map is the general paucity of county atlas coverage in the rural South. Because of the Civil War and its aftermath it is understandable why there would be no great demand

for county atlases in the Southern states in the 1860's and 70's. The fact that a market did not develop later is perhaps a reflection of the generally lower level of prosperity in the region and the lack of sufficient numbers of independent landowners who would be likely to purchase county atlases or plat books. The Middle West has been, unquestionably, the greatest market for these volumes as well as the major producing area. County atlas publishing expanded notably in the Pacific Northwest in the 1920's and 30's, with Portland, Oregon and Tacoma, Washington as the principal publishing centers. Most of the atlases covering counties in the states of the Northwest orginated from these cities or other less important centers in the region. Since the early part of this century there has not, apparently, been a great market for county atlases in the rural areas of the north Atlantic states. However, in that region, and in some other areas, property and street atlases covering the whole or large portions of predominantly urbanized counties have been produced commercially. The county atlas coverage of southern California is of this type.

County atlas and plat book production has fluctuated considerably from year to year and from period to period. Only about half as many county atlases appeared in the 1880's as were published in the previous decade, or in the succeeding one. Since 1890 at least three hundred county atlases or plat books have been published in every decade, and for some decades the total number is about twice this figure. During the years of World War I there was a slight decline in production and a profound one during the depression years of the 1930's. This lower production continued during the period of the Second World War, but after 1945 the number of plat books published increased greatly. Approximately one hundred new plat books have appeared annually from the mid-1940's to the present time.

Utility of County Atlases and Plat Books

The value of privately-produced county atlases and plat books is recognized by county surveyors, who are responsible for official cadastral mapping. This official coverage is usually in the form of original maps of individual townships in the county, which are amended as property changes occur. Because there is often no provision for copies of these master maps to be deposited in county archives at specified intervals, official cartographic coverage provides a record only of current cadastral patterns. County surveyors will supply copies of their maps to the public, but some of these officials find it convenient to sell the latest commercially-produced plat books when cadastral map coverage is requested. Lawyers frequently refer to county atlases and plat books to establish facts of land ownership, the atlases being often the best and sometimes the only record available. These privately-produced atlases are also consulted by county tax officers.

Teachers in the social sciences find county atlases valuable documents for instruction in local geography, history and government. Although many of these volumes are privately owned, copies may be found in court houses and public libraries; some historical societies collect county atlases assiduously.

To geographers in general and to historical geographers in particular the county atlas and plat book offers a wealth of usuable information. A

single atlas usually provides uniform and detailed map coverage of a county unit at a given date. Occasionally, large blocks of counties were mapped in essentially the same fashion by one concern, in a short space of time. The township plats in the atlases make possible the reconstruction of features of earlier landscapes such as road patterns and property boundaries. In a county courthouse in rural Ohio the writer saw a map compiled by a superintendent of schools showing the distribution of early one-room schoolhouses in a particular area. The information was supplied largely from county atlases; it would have been very difficult, if not impossible, to have constructed the map without this source material.

If an area has been covered by county atlases at different dates, interesting and useful comparisons can be made respecting changes in the landscape. Other source materials may provide essentially the same information but more often the data are unavailable or at best scattered. The maps contained in the atlases have survived by virtue of the fact that they are bound in volumes; while separate sheet maps, which are more difficult to preserve have, in many cases, perished. This includes maps on which the atlas coverage itself is based. Historical geographical studies may be greatly facilitated by the use of county atlases which are convenient, but sometimes neglected, sources of information.

The privately-produced county atlas of the United States has been regarded as a rather inelegant monument to the vanity of man. Perhaps it may be considered, with more justice, as a rugged tribute to agricultural America and to the economic system of which it is a product.

THE CHANGING TIMES AND GREAT BRITAIN*

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This paper attempts to summarize much material available on Great Britain in the hope of organizing some concepts into a useful structure. Great Britain's former great stature among nations, still thought to exist by some people although that nation is now of secondary importance, needs wide publicity. A knowledge of this situation is of critical importance to the United States. The people of this country in attempting to understand the intricacies of relationships among nations must always be cognizant of rising and descending nation-powers of significance in the international scene.

Whether or not Great Britain is a great power is a subject of much argument. This writer believes she is not for these reasons: 1) she cannot make decisions of an international nature without considerable concern over the reactions of other nations; 2) she does not have under her immediate control many of the sources of raw materials needed by a modern industrial power; 3) she lacks the economic potential to carry on an all-out thermonuclear war--for an all-out war Great Britain lacks the capital and natural resources to prepare for it, and once such a war begins there will be no time to build up production and 4) Great Britain lacks the space for even a remote chance of significant survival should a thermonuclear war be directed at her—perhaps no nation has space for this. Now let us see how, through the course of events, Great Britain reached her, at best, second-rate status among nations.

Great Britain began on the road to industrial preeminence early and reached her peak of industrial glory in the 19th and early 20th centuries. Her beginnings were based on raw materials at home—to name a few and the most important—iron, wool, coal, and clay. Woolen goods, for example, accounted for over half of her exports in 1700. With the supremacy of the steamship, but before diesel engines, coal became a significant item of export. The iron and coal resource base and its importance to British industry is, of course, well known to all. In general, her basic raw materials were cheaply available and could be easily fashioned into the relatively simple products of the time.

Great Britain obtained capital for development from a prosperous agriculture (grain was an export commodity until about 1750), from her commerce, and from foreign sources, apparently Dutch and German. Labor was plentiful on the island, and skilled labor not available was often imported. For example, foreign technicians were employed to smelt copper at Keswick. As industry expanded, the market at home was somewhat self-generating.

The Empire probably did not become important until after Great Britain was well on the road to industrialization, and in all probability the Empire and the later Commonwealth cost more than they were worth. Both Disraeli and Adam Smith thought that the Empire was not a paying pro-

* The writer wishes to acknowledge that the use of the term Great Britain is inaccurate for part of this paper. In the span of the changing times from the 1600's to the present, however, it is more appropriate than the term United Kingdom.

position. But certainly the world is better off for the civilizing effects of the British even though they did increase the population by spreading certain concomitants of the industrial revolution (among others, a little cleanliness, some medical care, and increased food supplies).

As products became more complex and increased in variety, additional raw materials were obtained from the colonies. Britain, over the years, possibly could have obtained these at less cost on the open market. Proponents of this argument forget, however, that Great Britain provided orderly government and a safe *milieu* for capital investment that might otherwise have been lacking. It is possible that preferential trade with colonies and the Commonwealth did Great Britain a dual disservice—high costs of raw materials just mentioned plus a built-in market that made for British industrial obsolescence because competition was not truly operative. In recent years the age-old British industries of mining, quarrying, textiles, clothing and china have suffered less than average increased development, accounting for the average industrial production index being lower than might be expected.

The creation of the Empire trade fashioned lifelines and political units that needed control and protection and these cost more, probably, than the profit from trade. At the same time, to protect the empire, the navy was built which was the symbol of British international power for more than 100 years before World War I. The post-world War I rise of air power supplanted British symbols of control.

As industrialization increased in the world, Great Britain had competition—in textiles from India, Japan, and the U. S., and in heavy industry from the U. S. and Germany, to name a few examples. In both World War I and World War II, but particularly the latter, Great Britain was unable to supply her overseas markets, and competitive industries sprang up in other countries; she fostered new industries in some Commonwealth lands during World War II. More than this, modern industry uses many raw materials, many of which are not found in significant quantities within Great Britain (petroleum and several alloy metals are illustrative of this situation), and her own basic mineral raw materials have been in use for a long time; hence, the high-quality, easily-obtained ores are largely depleted. Also, because of increasing product complexity requiring more use of foreign raw materials Great Britain's ability to compete with other nations has been reduced.

At the close of World War II Great Britain was handicapped by: 1) the job of rebuilding at home; 2) continuing defense costs; 3) competition from Commonwealth and other countries in the world's markets; 4) a Germany that being denied defense expenditures, could devote all capital outlay to building a modern industrial system; 5) a blossoming industrial Japan.

What is Great Britain's future, remembering that she must import many raw materials; that she must increasingly meet additional competition; that she must make enough profit from fabrication and international services to provide about 50% of the food she consumes; that many financial services formerly provided by Great Britain are now supplied by international organizations and the U. S., that many commonwealth countries

are increasingly interested in their own regional economic alliances, and that Great Britain can compete effectvely in some industries, such as, chemicals, vehicles, engineering, electrical goods, paper and printing?

It is postulated that Great Britain should encourage and join a broadened European Common Market that would include most if not all of Europe. This would give Great Britain access to a large free-trade area. She should lessen her dependence upon preferential Commonwealth trade and work unceasingly at more efficient production and the abolition of obsolete plant facilities and techniques. Great Britain cannot afford the use of labor that can be replaced by more efficient machines which can give lower per unit cost production. She is today significant for her past contributions to Western civilizations and she will remain a bulwark for democracy and industrialism but she can best operate in concert with other countries, especially those of Europe. Great Britain should continue to pursue her world markets and to take an active role in collective defense.

GEOGRAPHY OF THE SIERRAS JUAREZ AND SAN PEDRO MARTIR, BAJA CALIFORNIA, MEXICO

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The Sierra Juárez and the Sierra San Pedro Mártir are two Mexican, crystalline highlands which are parts of the Peninsular Range. They extend, in line, southward for some one hundred seventy miles from the Laguna Mountains in San Diego County, California (Fig. 1).

Published materials have been concerned less with these high, timbered sierras of northern Baja California than with other parts of the peninsula because aborigines did not permanently occupy these areas nor were missions established in the mountain forests. Moreover, in the twentieth century economic development in northern Baja California has been concentrated on the Delta of the Colorado River and along the Pacific coast, while the northern high sierras have remained little exploited. Nevertheless, these mountains contain valuable natural resources which have in the past attracted temporary settlement, are today being slightly utilized, and in the future offer promise of increased exploitation.

That part of the Baja California peninsula in which the Sierras Juárez and San Pedro Mártir are located is a west-tilted fault block of which these mountains form the crest. The block consists mainly of crystalline rocks associated with a deeply unroofed batholith intrusion which recent investigations indicate was mid-Cretaceous.[1] On the east the crystalline core rises precipitously, as an escarpment, above the profoundly deep Gulf of California Diastrophic Trough. On the west the slope is much more gradual, especially in the Sierra Juárez.

Just south of the international boundary along the crest of the east-facing escarpment lies a series of narrow granitic ridges and piled masses of huge granite boulders known as the Sierra Juárez (Fig. 1). This sierra stands only slightly above the gently-sloping, old, erosional-surface plateau to the west, which is probably of Eocene age. The range itself includes many nearly level areas, known as *bajíos* in the higher, wetter places. Elevations range from about 3,100 feet at the United States border to 6,676 feet at Cerro Colorado, near the southern end of the sierra where the granite is buried beneath mesas of lavas, tuffs, and sediments.

The Sierra Juárez terminates at San Matías Pass (elevation 3,300 feet) which separates this range from the Sierra San Pedro Mártir to the south. This pass may be the eastern expression of the Agua Blanca Transverse Fault—a major strike-slip fracture zone extending to the west coast on the north slope of Punta Banda (Fig. 1).[2]

A slightly dissected fault block, which forms an elongated, corrugated plateau of granitic rocks, rises on the batholith south of San Matías Pass to

[1] L. T. Silver, F. G. Stehli, and C. R. Allen, *Lower Cretaceous Pre-Batholith Rocks of Northern Baja California* (Pasadena: California Institute of Technology, Div. of Geological Sciences, Contribution No. 799, 1956), pp. 1-11.

[2] C. R. Allen, L. T. Silver, and F. G. Stehli, "Agua Blanca Fault—A Major Transverse Structure of Northern Baja California, Mexico," Abstract in *Bulletin of the Geological Soc. of America*, LXVII (Dec., 1956), p. 1664.

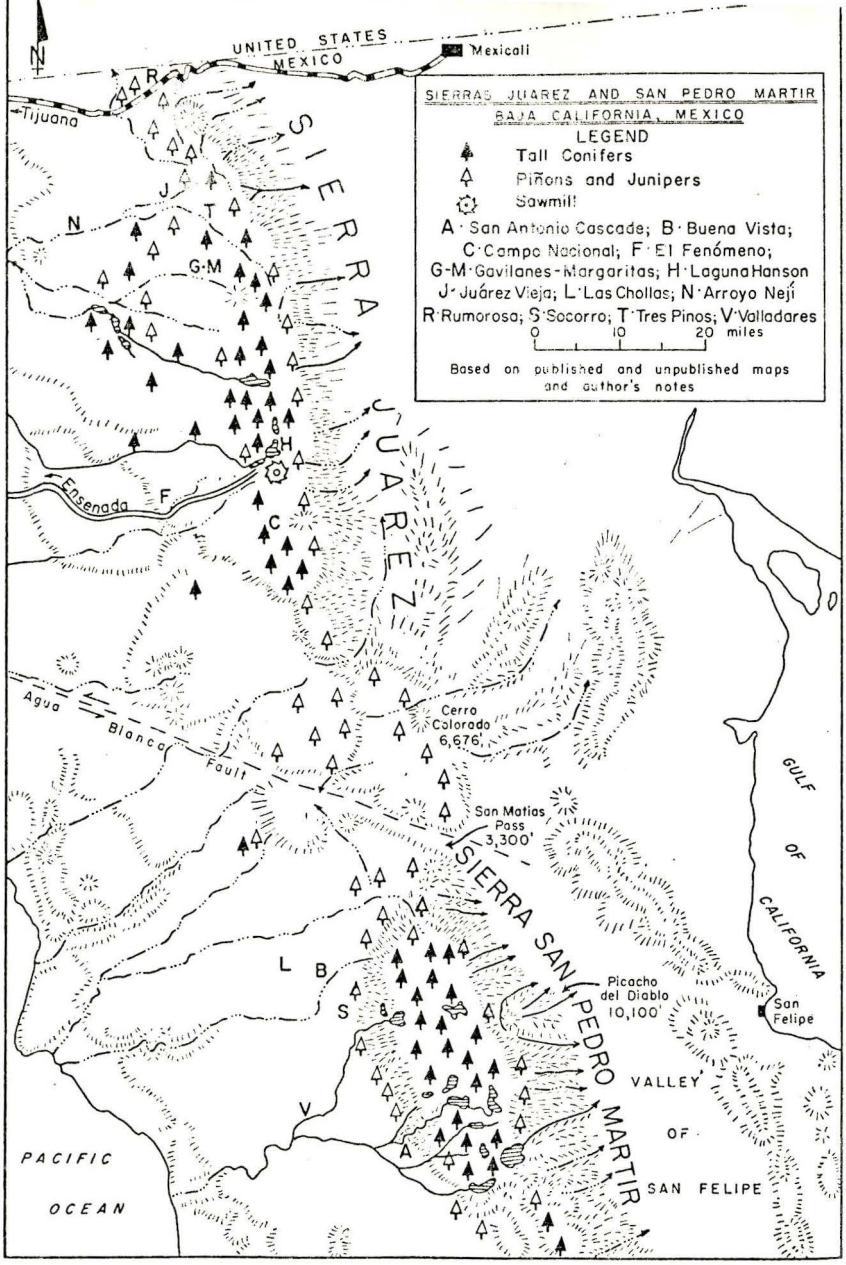
N
UNITED STATES
MEXICO
Mexicali
Tijuana
SIERRAS JUAREZ AND SAN PEDRO MARTIR
BAJA CALIFORNIA, MEXICO
LEGEND
Tall Conifers
Piñons and Junipers
Sawmill
A · San Antonio Cascade; B · Buena Vista;
C · Campo Nacional; F · El Fenómeno;
G-M · Gavilanes-Margaritas; H · Laguna Hanson
J · Juárez Vieja; L · Las Chollas; N · Arroyo Neji
R · Rumorosa; S · Socorro; T · Tres Pinos; V · Valladares
0 10 20 miles
Based on published and unpublished maps and author's notes
SIERRA JUAREZ
Ensenada
Agua Blanca Fault
Cerro Colorado 6,676'
San Matias Pass 3,300'
SIERRA SAN PEDRO MARTIR
Picacho del Diablo 10,100'
GULF OF CALIFORNIA
San Felipe
VALLEY OF SAN FELIPE
PACIFIC OCEAN

Fig. 1

form the Sierra San Pedro Mártir. On the plateau, which stands at 5,000 to 9,000 feet, are two marginal ridges which rise 500 to 1,000 feet above the plateau surface. Toward the Gulf of California from the more ser ated eastern ridge the escarpment plunges from the highest point on the peninsula, Picacho del Diablo,[3] (10,000 feet), to an elevation of some 1,500 feet in the Valley of San Felipe. Among the piles of gigantic granitic boulders at the base of the eastern ridge lie the delightful, pine-surrounded, grassy basins and wet meadows which have given that part of the plateau the name Los Vallecitos.[4]

Meigs has classified the climate of most of the area in the sierras of Northern Baja California as Mediterranean, hot-summer, Koppen Csa).[5] The same author has called the climate of Catalina mesas, at the southern end of Juárez Range, hot steppe-desert transition (Köppen BSh), and that of the highest parts of the San Pedro Mártir microthermal, dry-summer (Köppen Ds).[6] Climatic records at Rumorosa, El Compadre, and Ojos Negros indicate that the annual precipitation in the Jeffrey pine forest to the south and east is probably fifteen to twenty inches.[7] May and June are the only months that are, in some years, devoid of precipitation. Snow falls and frosts are frequent every winter in the San Pedro Mártir and in the higher parts of the Sierra Juárez. Summer rainfall is heavy enough in the San Pedro Mártir to make the dry-summer climatic classification doubtful. No climatic stations exist in the forest of the San Pedro Mártir, but annual precipitation there is probably as much as thirty inches. Both of the sierras are wetter than the lands to the west and east of them.[8]

The only coniferous forests with merchantable timber on the peninsula cover most of the surface on the highest and wettest parts of northern Baja California, the Sierras Juárez and San Pedro Mártir. On the west these forests are bordered by chaparral, and on the east the conifers give way abruptly to species of the vegetation association of the Colorado Desert. Large stands of Parry piñon pine (*Pinus cembroides parryana* Voss.) and one-leaf piñon (*P. cembroides monophylla* Torr. and Frem.) are found on the dryer, lower edges of the sierras down to about 3,000 feet. California juniper (*Juniperus california* Carr.) grows in association with

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[3] Also known as La Providencia, Cerro de la Encantada, Calamahué Mountain, and Cerro Santa Catalina.

[4] For a detailed description of the geology and landforms of the Sierra San Pedro Mártir see A. W. Woodford and T. F. Harriss, "Geological Reconnaissance Across the San Pedro Mártir, Baja California," *Bulletin of the Geological Soc. of America*, XLIX (Sept., 1938), pp. 1297-1336.

[5] Peveril Meigs, *The Dominican Mission Frontier of Lower California* (Berkeley: University of California Pubs. in Geography, 1935), VII, p.14.

[6] Ibid., pp. 14, 126.

[7] Data from the files of the Secretaría de Recursos Hidráulicos, Dir. Gral. de Hidrología, Sección de Climatología, México, D. F. Sixteen years of record are available for Rumorosa.

[8] Annual average precipitation at Ensenada is 13 inches, and at Mexicali is 2.98 inches. At San Felipe most years on record have less than 4 inches of rainfall. Data from Jorge A. Vivó and José C. Gómez, *Climatología de México* (México, D. F.: Instituto Panamericano de Geografía e Historia, 1946), Pub. No. 19, p. EM2, and from the files of the Servicio Meteorológico Mexicano, Dir. Gral. de Geografía y Meteorología, Mexico, D. F.

the piñons. A large piñon forest extends northward from the Tres Pinos-Neji Arroyo, in the Sierra Juárez, to the international boundary (Fig. 1). From the Tres Pinos-Neji Arroyo a nearly pure stand of Jeffrey pine (*P. jeffreyi* Murr).[9] extends southward through the *bajios* (mountain meadows) to the volcanic mesas at the southern end of the Sierra Juárez.

In the San Pedro Mártir there is a mixed coniferous forest dominated by Jeffrey pine. The next most abundant species here is lodgepole pine (*P. contorta* Dougl.), which is found at elevations over 7,500 feet. Other trees which grow in the forest of the San Pedro Mártir are sugar pine (P. *lambertiana* Dougl.), incense cedar (*Libocedrus descurrens* Torr.), white fir (*Abes concolor* Lindl. and Gord.), and aspen (*Populus tremuloides* Michx.).

Most stream run-off from the Sierras Juárez and San Pedro Mártir flows toward the Pacific Ocean because the climate is more moist and the catchment basins are larger west of the crest of the fault block than they are east of this peninsular drainage divide. The majority of the streams in northern Baja California originate in the high sierras, and many of them have their headwaters in the high mountain meadows in which standing water accumulates in wet years. Laguna Hansen, in the Juárez Range, is the largest of these intermittent mountain lakes, and its waters have covered as much as 500 acres. From the meadows the streams flow westward. Those of the San Mártir tumble off the upper plateau in rapids, and on the San Antonio branch of the Río Santo Domingo, in a high cascade (Fig. 1).

In all but the cool, moist months the streams disappear in their beds before they reach the sea. In wet years one or several may reach the sea all year. East of the crest of the sierras small streams follow numerous canyons cut into the face of the escarpment. Here permanent waters cascade the desert where they are lost in sands.
over steep surfaces, and flow through enchanting palm-lined pools toward

In the Sierras Juárez and San Pedro Mártir mammals which are the subjects of hunters are more abundant than they are in the more settled and accessible lower areas. However, even here, especially in the Juárez Range, where there are automobile roads, wild game has been badly depleted. The mule deer (*Odocoileus hemionus fuliginatus* Cown) and the mountain lion (*Felis concolor californica* May) still inhabit the sierras. On the dry, precipitous east slopes of the mountains, in what Griffing Bancroft has called "the most inhospitable region in temperate North America," the mountain sheep (*Ovis canadensis cremnobates* Elliot) survives in considerable numbers, isolated from all but the hardiest of hunters.[10]

Water fowl, quail, and pigeons are still hunted in the mountains, but are less numerous than they were fifty years ago. The magnificent, giant California condor (*Gymnogyps californianus* Shaw) apparently disappeared from the sierras in the nineteen-thirties when the last individuals

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[9] J. Robert Haller, *Taxonomy, Hydridization, and Evolution in Pinus ponderosa and P. jefferyi* (Ph.D. dissertation, University of California, Los Angeles, 1957), p. 1; Fig. 1A.

[10] Griffing Bancroft, "The Faunal Areas of Baja California del Norte," *Condor*, XXVIII, No. 5 (Sept.-Oct., 1926), p. 210.

were reported in the San Pedro Mártir. Slaughter of this bird for sport and for its quill feathers, the hollow bases of which were used as gold-dust receptacles, probably accounts for its eradication.

A geographically isolated species of rainbow trout, the Nelson trout (*Salmo nelsonii* Evermann), is found in the Sierra San Pedro Mártir. This boreal kind of fish was found originally only in the San Antonio branch of the Santo Domingo River, but has since been planted in other mountain streams.

Man's utilization of the natural resources of the sierras of northern Baja California on a large scale dates from only the last three decades of the nineteenth century. Indians penetrated the high country to hunt and to gather piñon seeds, and mission livestock herds grazed lush mountain meadows in the San Pedro Mártir for a few years.[11] By the mid-nineteenth century, cattle from ranchos located west of the sierras were pastured in the mountains.[12]

It was, however, gold-rushes, which occurred between 1870 and 1900, that brought concentrated human occupation and large-scale exploitation of natural resources to the sierras. Mining camps were established in, and at the western edges of, the mountains; cattlemen increased their herds to meet the demands of prosperity; timber was cut for construction and mine timbers; and professional hunters began to despoil game for meat and deer skins. Since the gold rush days, utilization of natural resources in the sierras has fluctuated in intensity with mineral discoveries, but has also increased generally with the economic growth of northern Baja California.

Today the major value derived by man from the Sierras Juárez and San Pedro Mártir is that imputed to irrigation and drinking water. About sixty per cent of all irrigated land lying west of the sierras, or some 24,000 acres, is made productive by surface or underground water which flows toward the Pacific Ocean from the water sheds of the high mountains.[13] Moreover, the major source of drinking water for the city of Tijuana, with 130,000 inhabitants, is the Río de las Palmas, and this stream has its headwaters in tributaries in the Sierra Juárez.

Forage consumed by livestock on the ranges of the Northern Baja California mountains is second to water among the values derived by man from the sierras. There are approximately 550,000 acres of grazing land within the areas of coniferous forest in northern Baja California. Grasses, forbs, and sedges are plentiful on the meadows, and also grow under the trees. Thus, the northern sierras contain the best ranges in all of the Baja California peninsula. Although recent dry years have brought about a reduction in herd size, there are probably still about 9,000 head of cattle, that is, about twenty per cent of all beef cattle in the State of Baja California, which graze the ranges of the high sierras at least part of the year. Some eight to ten thousand sheep, or about one-half of the sheep in the State,

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[11] Meigs, *op. cit.*, p. 127

[12] Ulises U. Lassepas, *De la colonización de la Baja California y decreo de* 10 *de marzo de* 1857 (Mexico: Imprenta de Vicente Garcia Torres, 1859), pp. 142-143.

[13] Other sources of irrigation water west of the Sierras Juárez and San Pedro Mártir are the watersheds of the coastal mountains, aquifers in interior basins, and geologic water trapped beneath the San Quintín Plain.

are driven yearly by Basques over public and rented private ranges between Tijuana and the San Pedro Mártir Mountains. Individual ranching operations, with the exception of the sheep drives, are small because Mexican agraian law limits ranch and ranch-based herd sizes.

The State of Baja California is perhaps the poorest of all Mexican states and territories in forest resources. Only .23 per cent of the forested area of Mexico is in this state.[14] Nevertheless, the approximately 225,000 acres of tall coniferous forests in the State, excluding piñon areas,[15] could meet more than the local needs for lumber if the forests were fully but judiciously exploited.

Present local yearly demand for lumber is twenty-six million board feet. Actual production is only one milllion board feet, but reserves of merchantable timber probably are between five and ten billion board feet. The virgin forest of the San Pedro Mártir has even attracted surveys by American companies interested in exporting lumber from Baja California.

Although small sawmills had operated intermittently in the Sierra Juárez for some forty years, it was not until the mid-nineteen fifties that timber cutting there began on a scale large enough to support a lumber camp. Today the only sawmill in northern Baja California is operated at El Aserradero by members of the forest and ranching *ejido,* Sierra Juárez —the largest *edjido* in all Mexico.[16]

Firewood for kilns is cut by lime miners from the piñon forest at the northern end of the Sierra Juárez. Juniper trees are logged commercially for sale as fence posts.

Although small scale gold placer mining dating from the mission period was followed after 1870 by gold rushes to the plateau west of the Sierra Juárez, gold mining in the Juárez Mountains did not begin until the nineteenth century. Then as large placer deposits were opened, mining camps sprang up at such places as Juárez Vieia, Tres Pinos, and Campo Nacional (Fig. 1). At Campo Nacional the gold came from Cerro Prieto, A flat-topped hill of well-packed, dark-colored auriferous metamorphic gravel. This dark-colored rock is not found on the granitic batholith in the area of the Cerro Prieto gravels, and thus the gravels are believed to have been deposited by large streams, flowing from the east, which antedated the Gulf Diastrophic Trough. By the end of the nineteenth century gold was also being mined, mostly from placers along the western edge of the San Pedro Mártir at such camps as Socorro, Valladares, Buena Vista, and Las Chollas (Fig. 1).

Disturbed economic and political conditions during the early years of the Mexican Revolution suspended mining in the sierras of northern Baja

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[14] Jorge L. Tamayo, *La República Mexicana y la Baja California* (Mexicali: Edicones ACPA, 1956), p. 75.

[15] Statistics relevant to timbered area, lumber production and demand, and timber reserves were supplied by Ing. Ramiro García Perez, Mexican government forester in northern Baja California.

[16] An ejido is a Mexican communal land-holding. For the size of *Ejido* Sierra Juárez see Ramiro Garcia Perez, *Problema forestal y social de "Sierra de Juárez" en el Estado de Baja California* (Published thesis, Escuela Nacional de Agricultura, Chapingo, Mexico, 1956), pp. 3-4.

California, but during the years between 1920 and 1940 the gold placers were reworked intermittently. The rise in the price of gold in the United States in 1933 brought another gold rush to the Sierra Juárez, and for some five or six years activity at the old placers was brisk. However, by 1937 most of the gold had apparently been mined. Mining along the western edge of the San Mártir never recovered from the suspension of operations imposed by the Mexico Revolution and worked-out placers.

After 1937 tungsten extraction in the Sierra Júarez became the most important mining activity in northern Baja California, although *gambusinos* (prospectors) still rework the gold areas. Tungsten is found in sheelite, a contact metamorphic mineral which was formed in tactite rock.[17] The tactite replaced calcareous beds of marble where the marble rested as roof pendants on the batholith. Between 1937 and 1943, in response to high tungsten prices before and during the Second World War, 100,000 tons of tungsten ore were milled at El Fenómeno (Fig. 1). Later, during the Korean War, mills operated at Gavilanes and Margaritas (Fig. 1). Low prices today have forced the suspension of tungsten mining in Baja California.

The only active mining carried on in the sierras of northern Baja California today is centered just west and south of the town of Rumorosa. In 1928 the mining of lime from roof pendants of marbleized limestone began here and still continues. One large mechanized, and twenty-two small, primitive kilns are in operation near Rumorosa. The lime is used for mortar in the urban centers of northern Baja California, but total production is small.

As most soils in the sierras are thin, coarse lithosols or acidic, wet meadow soils, there is little land available for agriculture. Farming has never been important, but a few ranchers do raise such crops as beans and potatoes on a subsistence basis, and grain and clover fodders are planted in small fields to supplement range pasturage.

Probably the least developed, yet potentially most valuable, source of income in the Juárez and San Pedro Mártir Mountains is recreation. Although the outlines of a national park in each of the sierras have been established, and hunting laws exist, game wardens are so few and governmental financial resources so limited that little has been done to regulate hunting or promote recreation in the mountains. It would seem that a well-financed program aimed at restoring wildlife, and developing streams, to be planted with native trout, would in the long run pay for itself many times over in income derived from recreation. However, the most limiting factor in the promotion of recreation is the almost total absence of good roads.

Although the paved Tijuana-Mexicali highway crosses the northern end of the Sierra Juárez, the rest of the range is traversed only by poor dirt tracks and roads (Fig. 1). The main road leads northward and southward out of El Aserradero from which lumber is trucked to Mexicali and Ensenada. Log roads, now abandoned, were built in 1950 from Buena Vista

[17] Carl Fries and Eduardo Schmitter, "Sheelite Deposits in the Northern part of the Sierra Juarez, Northern Territory Lower California, Mexico," *Geological Survey Bulletin*, No. 946-C (Washington: U. S. Dept. of Interior, 1945), p. 73.

and Socorro to the San Pedro Mártir in anticipation of logging operations which did not materialize.

Only the residents of the sierras and the hardiest of tourists now use the mountain roads or invade the San Pedro Mártir on horseback. Good roads could attract thousands of sightseers and many sportsmen to the sierras annually. The income derived from these visits to the mountains would probably exceed that now gained from all other sources of revenue in the sierras.

SUMMARY

Ranchos, mining booms, and watersheds in the Sierras Juárez and San Pedro Mártir, and the slaughter of game and the cutting of timber in these mountains, have all contributed to the economic development of northern Baja California. However, today man's subjugation of nature for agricultural production on the Delta of the Colorado River, and his creation of amusement and tourist centers, to serve hoards of Americans, between Tijuana and Ensenada have left the sierras of northern Baja California as thinly populated and little used areas lying between the main currents of economic life in the State of Baja California.

The future economic value of the Juárez and San Pedro Mártir Mountains rests in the husbanding of their watersheds, and the careful development of lumbering and recreation. These mountains have the potential natural resource capicity to supply some 24,000 acres of farmland with irrigation water, much of the domestic water needs of the city of Tijuana, the lumber needs of the State of Baja California, and a large income from recreation. With a population of over one-half million persons, and a population increase of nearly six hundred per cent between 1940 and 1958,[18] there is little doubt that more income from, and more jobs in, the Sierras Juárez and San Pedro Mártir will soon be needed in the State of Baja California.

[18] Based on data from the office of the Oficiál Mayor of the State of Baja California, and *Anuario estadistico de los Estados Unidos Mexicanos* 1955-56 Sec. de Economia, Dir. Gral. de Estadistica (Mexico: Talleres Gráficos de la Nación, 1957), pp. 35-6.

THE ROLE OF GEOGRAPHY IN GENERAL EDUCATION*

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There exists today an amazing educational paradox in our society, a society dedicated to the proposition that the best interests of individuals and of society alike are served most effectively through the general education of all its members. There is, on the one hand, ever-increasing need for more widespread and competent understanding about our world and all its troubled parts of our own communities and regions. On the other hand, there is a serious underemphasis, if not complete neglect, in our schools of the one discipline which has been given the specific responsibility for defining the concepts, formulating the principles, perfecting the techniques, and propagating the knowledge on which such understandings rest, the discipline of geography.

There is, and can be, no more difficult problem in education than that of deciding just what out of our vast store of knowledge is so basic and essential that every member of society should be given command of the material through our formal processes of education. Complete agreement is impossible, but we are obligated, if we believe in general education, to endeavor to distinguish what is essential by its very nature from that which is desirable but not essential. Every subject selected needs to be chosen, not alone on the assumption that it is useful, but on rational evidence that it fulfills a greater need than any subject potentially, or actually, displaced.

This ideal is hard to achieve, and, in one respect, it has failed. Geography has been partially or totally displaced in the effective education of most of our students, and, it must be contended, by less essential courses; for there can be no successful general education in which the fundamentals of geograhy are neglected or inadequately grasped.

To such a statement there must necessarily be general disagreement, otherwise geography would have reasonable emphasis in our schools and the paradox would not exist. But if this proposition is true, those charged with the heavy responsibility of determining our general education curriculums should demand, and consider, all rational evidence and pertinent arguments; those trained in the discipline should prepare the arguments and accept the burden of proof.

There needs to be a meeting of minds, but, unfortunately, any promotional work done in behalf of geography runs headlong into a massive wall built of interlaced misconceptions and confusions about the nature of the field. There are at least three prevalent misconceptions which, unless dispelled, almost guarantee that geography will—and must—be held in low esteem.

As one misconception, many people conceive geography to be the memorizing of place names and locations. Contributing to this fallacy are those sincere but mistaken teachers who require students to learn names

* A committee report written for The California Council of Geography Teachers.

and locations and, in so doing, credit themselves with teaching geography and convince their students they are learning geography thereby. Name-location exercises have a very real value and are essential, not alone to geography, but to every discipline that pretends to deal with world realities. But memorizing names and locations as an end in itself is no more geography than memorizing dates and period labels constitutes history.

A second misconception all too prevalent is that geography entails nothing more than the amassing of geographic facts such as the inexcusable facts asked of contestants on our popular quiz programs who have chosen the category of geography. The error in such a misconception lies in the fact that there are no such things as geographic facts. Facts are facts. Events are events. Neither is anything more and neither belongs to any discipline. Facts and events constitute the realities of the world and are infinitely diverse in space and time and capable of analysis and interpretation from many points of view. Selected facts constitute the subject matter of geography, but any or all of these facts may be studied and interpreted to other ends by other disciplines. Geography, as every other science, is defined by its hypotheses and propositions and not by the facts investigated.

A third misconception about geography is that it is solely descriptive and not analytical and interpretive. Although landscape and regional description is an essential part of the process of geographic investigation and reporting, it is not the final purpose. Description for its own sake is art, not science. In the early grades, where youngsters lack factual information or the intellectual maturity to interpret complex relationships, geographic study entails much description, to be sure. But it would be illogical to construe from this that geography *is* description. Description, fact accumulation, and place-location exercises contribute information, not understanding, and are, therefore, means, not ends.

Eradicating such misconceptions, however, would not alone assure a disposition favorable to geography for there are reasons why even those who seek to understand the field should be confused. The word *geography* itself is a source of confusion. This word has become one of those common terms used loosely, vaguely, and often incorrectly to such an extent that it has, at least in public, lost much of its scientific connotation and academic utility. Regularly in newspapers, popular periodicals, and even educational journals, references are made to the "geography" of some place or other. This every-day usage convinces the reading public that geography is something that exists on the face of the earth—the terrain, observable features of the landscape, or, perhaps, vaguely, all the things seen and unseen that should supposedly be associated with place names. This popular use of *geography* as an ambiguous collective term tacitly acknowledges a need to know the realities of the world, but it also permits us merely to stipulate such knowledge. The consideration of local, regional, or world conditions by word alone becomes a perverse habit of mind that, unfortunately, satisfies. The word *geography*, therefore, becomes a symbolic substitute for real knowledge and understanding. As a result, the study of geography is disregarded easily and the discipline dismissed by nothing more nor less than intellectual default.

A second reason for confusion stems from a basic problem in teaching. Geography deals with the realities of the world and, in its elementary aspects, studies such seemingly obvious things as forests, soils, weather, rocks, rivers, farms, cities, highways, and on through the list of familiar things. This emphasis leads many laymen to conlude that geography is simple and geographers naive. But how many of our adults can define a forest accurately enough for the ends of true understanding? How many can use the word soil without being vague, ambigous, or incorrect? How many so understand their own communities that they can classify them according to function or location? How many can explain the relation of the bedrock in their area to local terrain, water supply, soil fertility, engineering problems, or industrial opportunity? It is precisely the attention paid by geographers to the things we normally take for granted, or study only out of context, that should commend geography to those interested in general education. However, confusion arises from this aspect of geography because it leads many to believe that geography is concerned primarily with material that belongs rightly to other disciplines. It is, of course, the responsibility of the analytical natural and social sciences to define and interpret individual phenomena or categories of phenomena from the viewpoint of their nature and origin. Geology provides us knowledge of rocks, geomorphology of landforms, botany of plants, anthropology of races, and so on. But geography deals with all such things, too, mapping their distribution, interpreting their spatial interrelationships, and generalizing on their location, and, must, therefore, teach sudents. not yet familiar with such things, enough about them to serve the needs of geographic study. This is an incidental and time-consuming duty, but a necessary one that actually enhances the value of geographic study for the purposes of general education. Nevertheless, it leads some people to believe that geography is nothing more than a little bit of thinned-down geology, meteorology, botany, economics, sociology and political science.

A third cause of confusion about the nature of the discipline comes about through mistaken identity. Those who do not habitually define a field in terms of its intellectual responsibilities continually confuse geography with parallel activities. Yet it is quite one thing to be an explorer, journalist, literary traveler, or novelist, all of whom may describe and interpret to some end conditions over the world, and quite another to be a person doing geographic work. Non-geographers may very well do a far more entertaining, rousing, and readable job of describing peoples and places and a more thorough job of collecting detailed facts than geographers, but without even approximating the requirements and needs of geographic analysis and interpretation. It should be realized further, to help dispel confusion, that since reality cannot be subdivided the way its study is subdivided into academic compartments, scholars in every field, by necessity, often do some work which is geographic although their work as a whole cannot be so labelled. Conversely, not everything done by geographers is geography.

Once misconceptions and confusions have been eliminated, it is not difficult to see that geography is a field of study and not a thing, a landscape, a collection of facts, not even an area and all its content. It is, instead,

a science with certain specific responsibilities delegated to it by our academic formula and educational system.

To meet its obligations as a science, geographic work, unlike parallel but unscientific activities, must be objective and not subjective, emotive or prejudiced. It must describe and interpret what is normal in every part of the earth and discuss the abnormal, the spectacular, or temporary only to the degree that they are important in understanding normal ranges of deviation. And, finally, geographic analysis and presentation must be comprehensive, considering all significant elements and all pertinent factors of explanation inherent in the area or feature of study. In this troubled world, wherein we are constantly exposed to news of the unusual, informed primarily only of important people, facts and events, and bombarded by subjective reports and single answer explanations, all of which serve to distort or caricature the truth, geographic knowledge and study serve as an intellectual antidote. Mass communications tend to create in us warped views of the world and its people unless the flood of information is evaluated properly by minds which already comprehend world realities in their normal relations. To help prepare minds for such world understanding is one end of geography.

Toward this and other ends, all courses in geography have certain aims essential to a general education. One is to help students develop a mental map of the world that fosters and facilitates global orientation, perspective, and thinking. Another is to help students to a conscious awareness and comprehension of the content of natural and cultural environments of the earth. A third is to give students sufficent command over the spatial factors of explanation to enable them to begin to understand the earth mosaic.

These instructional aims, however, do not define the basic and manifold responsibilities of geography in man's general pursuit of knowledge. Geography takes its place among the sciences as the Science of Spatial Relations. As such, it involves, as one of its approaches, the study of the distribution of things important to our understanding—things large and small and things distributed broadly over the face of the earth or as details within the smallest of areas—from playgrounds in our town and resources in our region to strategic areas in our struggles for economic efficiency or global power. This aspect of the field is often essential in, and complementary to, the work of the analytical disciplines and to planning. Geographic study also involves the definition and delineation of physical and cultural regions of every type and complexity essential to the purposes of area analysis. Regions are to geographic study what epochs, eras, and periods are in our study of history, and are as useful and as vital. A third function of geography is to examine, in all their complexities, the reactions of people to, and within, their natural envionments: that is the *man-land* relationships. This, in particular, is the bridging function of geography which provides the connecting link between the physical realities studied by the natural sciences and the cultural realities studied by the social sciences. In short, the functions of geography are to define the significant physical and cultural features of the earth, to analyze and interpret their distribution and regional patterns, to make them understandable

by explaining the basic forces, or factors, underlying their existence, and to show how they are complexly and causally interrelated according to location and areal association.

To those who think the business of education is to provide students with all the facts and ideas they need to know, the responsibilities listed above must seem not only staggering but quite impossible to accomplish. It would be ridiculous, of course, to attempt to give anyone factual knowledge or complete understanding about all the world's peoples and places in all their complex interrelationships. Geographic education, however, does not purport in the least to do this. Any formal science, certainly at pre-professional levels, seeks only to provide students with an adequate command of fundamentals and a useable framework of reference for use throughout life, and such is the aim of geographic education. The aim cannot be that of giving students selected facts they will need to know in life, for no one has foreknowledge of such facts. But since it is presumed that any student will, after his formal schooling, think about the world and localities important to him, geographic training can provide him with useable and useful concepts, principles, generalizations and viewpoints, and with certain skills and a referential body of factual knowledge. It is inevitable, after all, that people do considerable geographic thinking, for we cannot divorce our lives and problems from the reality of spatial existence. If we do not take advantage of known geographic knowledge and techniques, our untrained and normally inept geographic thinking is no better than, if as good as, that of primitive man.

The most telling argument for geographic education, however, has yet to be introduced. This argument rests on the assumption that, if education is not to be chaotic but is to be made effective through the command and organization of fundamentals, then each person needs to gain, through formal education, an integrated framework, or structure, of knowledge that enables him to deal effectively with the *whats, whens, wheres,* and *whys* of life. No one of intelligence in our society doubts the need to study individual phenomena and types of phenomena, consequently the analytical sciences have multiplied and flourished. Every phenomenon, however, is an expression of time and place as well as of being. If we wish to understand the real world, we need to know not only what things are, but we also need to understand them in their context of time and place. For this reason each person needs a well-developed time sense and an equally well-developed space sense as parts of their framework of knowledge. Responsibility for developing the time dimension is given largely to history, although it is shared with geology, archaeology, and certain other disciplines. The responsibility for developing the spatial dimension belongs to geography, which has essentially the full responsibility for developing the students' awareness of the patterned arrangement of all things—physical, biological and cultural—over the surface of earth. It is this responsibility, that of building one of the major dimensions of any adequate structure of knowledge, that makes geography essential to general education.

Although the respective responsibilities of history and geography to develop our intellectual orientation in time and space are complementary and equally vital, the study of history has universal approval, but the

study of geography does not. It cannot be concluded from this fact that geography is less important to general education, but only that we, as a people, have not been awakened to its importance. This is the basis of our educational paradox. Although a scientific and intellectually advanced people, we are, in general, ignorant of the fact that nothing whatsoever on the surface of the earth can be fully or rationally understood if we do not take account of, and interpret, its location and spatial relationships. We cannot deal intelligently with despoiled forests, depleted soils, strategic bases, urban slums, underdeveloped lands, or any other problems we have as inhabitants of this planet unless we localize each problem and analyze the complex spatial factors underlying their existence: but we seem scarcely aware of this truth. As a people who know many facts about our world, we are, nevertheless, geographically untutored, and, what is worse, we are unaware of it. We believe in integrated knowledge, yet we neglect the synthesizing service discipline of geography which, by its very nature, provides us our best system for integrating our understandings of world realities. Of what use, except to practicing specialists, is the knowledge gained from the analytical sciences if that knowledge cannot be applied to the understanding of real conditions in the current world simply because we are ignorant of the world? Of what value are courses in history if students do not know the product of historic change, the world of today or of any moment in the past? We are a people who limit our own knowledge and intellectual competence by our general failure to develop the spatial dimension of the framework of knowledge. It must be said again, there can be no successful general education in which the fundamentals of geography are neglected or inadequately grasped.

The question should not be, then, whether or not geography will be included in general education curriculums, but only what weight it should be given. The final answer to this admittedly difficult question needs to be found through the cooperation and continuous collaboration of all people sincerely interested in American education. But there certainly should be enough geographic study over the years of formal education that American students create for their own future use a completed framework of knowledge, one not lacking the spatial dimension. The aim should be that our students gain those understandings of the world that permit rational judgment and the making of wise decisions, for we are a democratic people with power not to be used unwisely and with a heavy burden of responsibility in this interdependent and troubled world. There should be no suffering on this globe because of basic ignorance on our part, for that deficiency can be remedied if we but will it.

THE CHILEAN DAIRY INDUSTRY*

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The seven million people of Chile are increasing at an annual rate of 1.9 per cent. The urban population, rapidly growing, now exceeds 60 per cent of the country's total population. Rising per capita food demands accompanying the urban development, and the increase in food requirements that comes of absolute population growth, have resulted in a 2.3 per cent (1948-50) annual rise in national food requirements. Yet food production increases at a rate of only 0.9 per cent and milk production increases at a rate of 1.25 per cent annually (1936-55).

Development of a gap between growth rates of population and food production is largely a post-World War II phenomenon. For the immediate future there seems to be little likelihood that Chile will overcome a dependence upon imports to make up the deficit in such staples of Chilean agriculture as wheat, potatoes, meat, and dairy products. The dairy deficit grows in spite of two decades of governmental and private efforts to increase milk production and improve distribution.

The origins of the Chilean industry and of attitudes toward dairying, as well as the nature of the contemporary scene, have been studied with the hope of suggesting why a product deficit has developed, and whether or not the country has the capabilities to overcome the deficit. The study of this representative industry, it was hoped, would afford the writer some insight into the nature of agriculture in Chile and, perhaps, in other countries of Latin America.

HERD DEVELOPMENT

Until the 1840's there was no serious attempt to modify Chile's foundation stock, the *criollo* decendants of cattle introduced to the New World from Spain. These hardy, slow-developing, 750- to 1,000-pound cattle were better suited to tallow and hide production than to use for draft, meat, or dairy purposes. Improvement in milk and meat producing qualities was achieved after the 1840's with fine cattle imported from Northwest Europe. The introduction of select stock was accelerated in the 1870's, when hardly a vessel anchored at Valparaiso which did not discharge one or two fine

* Material for this paper was gathered during field and office interviews, and from libraries in the Ministry of Agriculture, the two universities, and the I.C.A. office in Santiago. The work was done in 1957-1958, when the author was in residence in Chile on a Fulbright Grant. Published materials used to prepare the paper include: Ministry of Agriculture, Direccion General de Produccion Agraria y Pesquera, Deparamento de Economía Rural, *La Agricultura en el Quinqueñio* 1951-1955 (Santiago; 1957). Dairy Society International, "Report to the Administrator of the Foreign Agriculture Service," U.S. Department of Agriculture, F.A.S. Proj. No. 5-15-57-Dairy 6: Republic of Chile (Washington; May 1957); George H. Day, *Dairy Products Situation and Outlook in Chile,* U.S. Department of Agriculture, Foreign Agriculture Report No. 67 (Washington; March, 1952). R. Mardones and R. B. Cox, *La Alimentación en Chile* (Santiago; 1942). Luis Correa Vergara, *Agricultura Chilena* (Santiago; 1938). The periodicals, *Panorama Económico, El Campesino,* and the *Boletín* of the Sociedad Nacional de Agricultura were used also. The author appreciates the suggestions which his colleagues at Stanford made while the paper was being prepared.

cattle. While a number of breeds were introduced, Durhams, or Shorthorns, were preferred because they adjusted more readily to the rudimentary management practices of the period, and because when crossed with creole stock the offspring were improved meat, milk, and draft animals. The Durham blood was disseminated through the herds of central Chile so rapidly that by 1886 there were few cattle which did not show the line.

Because cattle breeders emphasized meat rather than milking qualities in devloping the Chilean Shorthorn, new breeds were introduced when dairying became fashionable. After 1900 the Holstein-Friesian (*holandes* in Chile), the red and brown Prussian (*overo colorado* or *clavel alemán*), and Brown Swiss and Normandy breeds won favor.

The Holstein was barely known in Chile prior to 1910, but by the 1930's crossses between it and the Chilean Durham predominated among the country's herds. Today the dominance of the Holstein-Friesian is as pronounced as was that of the Durham prior to 1920. It is the preferred breed in the full-time dairies; and cattle breeders like it because the young males are large beef animals and the heifers are in demand as dairy replacements. Reflecting the national interest in the breed is the registry record. The Holstein-Friesian comprises 69 per cent, and the brown or red Prussian variety 22 per cent of Chile's fine cattle. Argentine, European, and North American Holstein-Friesians (especially the latter) were imported on a large scale after the first World War. In recent years a buyer preference has developed for the West European Holstein. It is hardier, requires less attention, and is a superior meat-producing animal compared to the highly specialized North American milking Holstein. The European Holstein has a conformation that is similar to the early favorite, the Milking Shorthorn. It is particularly popular in the humid southern part of central Chile.

Nature of the Dairy Industry

Perhaps 25 or 30 per cent of Chile's 2,500,000 cattle are cows and heifers, and this proportion has remained fairly constant for some decades. However, the milking segment of the herd has grown from fewer than 200,000 head in the 1920's to around 475,000 to 500,000 head in the 1950's. The enlargement of the milking herd has occurred throughout cental Chile, but it is in the southern lowlands where the change has been marked.

In the Central Valley and in the lowlands of the flanking Coastal Ranges and Andes are nearly 94 per cent of Chile's dairy cattle. Most herds form part of a large general farming unit in which beef, grain, row crop, and fruit or vineyard production are prevalent. The milking operation may be specifically a dairy; it may be a phase of dual-purpose herd management; or it may be a fortuitous side-line in a beef-rearing operation. These various types of dairy operations produce about 90 per cent of Chile's milk. Most of the milk processing also occurs on the farm, with only a third of the total production reaching the market through factories or pasteurizing plants.

Over 70 per cent of the cows milked are spring and summer producers only (*lecheria de temporada*). Milking, performed in open corrals, customarily is done in the morning in the presence of the calves, which are tether-

ed while milking proceeds. Afterwards the calves are permitted to remain with the cows until early afternoon. While the procedure may benefit the young calves, the excitement, summer dust, and winter mud do not aid production or enhance the quality of the product. The seasonal milking pattern predominates from Colchagua (35° S.) southward.

Nationally the seasonality of milking results in a ratio of two or three to one between summer and winter production. The ratio is more striking in the humid south. Summer maximum milk reception at Temuco processing plants is six times the winter reception; in Osorno it is ten or twelve to one.

Dairy Regions

Central Chile may be divided into three zones of dairy activity: the North Central, South Central, and Southern. The nature of dairying in the zones reflects market access and certain physical characteristics related to climate.

The North Central Zone

The North Central Zone, extending from about 32° to 35° S., is climatically what the Koeppen system would identify as BSk to Csb. A five-to eight-month dry season and 12 to 40 inches of maximum winter precipitation are charateristic. This zone posseses about 22 per cent of the total milking herd and produces about 29 per cent of Chile's milk. Production may average about 4,000 pounds per cow per year. For the most part, operations are associated with a relatively small number of haciendas or *fundos*. Herds are comparatively well fed and cared for; they usually range in size from 100 to 300 head. Irrigated alfalfa provides the bulk of feed requirements. The regional emphasis in marketing is on fluid milk although a large quantity of cheese and whey butter is made during the summer in the more remote districts. Factory processing of butter, prodered milk, ice cream, and some cheese occurs. Perhaps 65 per cent of all milk production is received at the factories or pasteurizing plants.

The South Central Zone

In the South Central Zone, 35° to 38° S., the climate is transformed from Mediterranean Subtropical to Temperate Marine. The dry season lasts four or five months, and annual precipitation averages 40 to 60 inches. In this zone, where clover pastures predominate, 30 per cent of Chile's herd produces about 31 per cent of the country's milk. Production is estimated to average between 2,500 and 3,000 pounds per cow per year. Herds are moderate in size, averaging 50 to 110 head. The level of dairy technology is lower than it is to the north. There is fluid milk production for urban centers, especially near Concepción, but of greater importance is the amount of production for the manufacture of cheese, butter, and condensed milk. Most of the milk is processed on the farm, only 18 per cent of the total milk production passing through factories or pasteurizing plants.

The Southern Zone

Between 38° and 42° S. lies a region of extensive dairying where about 42 per cent of the country's milk cattle produce 33 per cent of the milk. In this Temperate Marine area (Cfb) precipitation, usually well distributed through the year, ranges between an average of 60 and 117

inches. It supports pastures, which usually are unimproved, and an evergreen forest where stock find winter browse. Some milking herds exceed 1,000 head, but the average operation involves 60 to 70 cows. Perhaps an average annual 2,000 lbs. of milk is produced per cow. This is the principal source area for cheese and butter. Condensed milk and powdered milk are manufactured also. Total factory reception of milk would amount to about 35 per cent of production. As in the South Central Zone, cheese and butter are made largely on the farm.

Productivity

As the Chilean herd is essentially dual-purpose, the low productivity may be expected. The national annual average production per cow is variously estimated at 2,800 to 3,853 pounds. (The U.S. average is about 6,150 lbs.) The low level of productivity is largely thought to be surmountable through changes in management attitudes and practices. There is widespread neglect or ignorance of disease control, nutrition, housing and handling methods, the adoption of which would be relatively inexpensive and remunerative. The deficiences of management are revealed in a calf birth rate which does not exceed 65 per cent nationally. Locally the calving rate may be as little as 25 per cent, and for the south as a whole it may be only 40 per cent.

The annual losses in dead stock, lost milk production, and from sterility attributable to disease is hard to calculate. However, the national level of brucellosis and tuberculosis infection is about 37 per cent each. Mastitis affects approximately 15 per cent of the cows. Foot and mouth disease is prevalent, but there have been no serious outbreaks since 1947.

Progressive operators, with the aid of dairy cooperatives, and the larger milk processing companies attempt to control the infectious diseases; and stringent culling may be practised. However, the average operator is not concerned with such matters. Some view disease and disease-caused death among livestock as natural phenomena which, like frost and drought, are inevitable. A few owners consider livestock illness to be a windfall source of low value meat which can be distributed to employees. The government has subsidized disease testing programs, but its agents neither may require inspection nor quarantine, nor compel the owner to treat, sell, or destroy diseased stock.

Feed deficiency in winter is a general problem. Malnutrition and starvation are recurrent in the south, where forage production is dependent entirely upon the elements. A few operators maintain adequate pasture area, but the provision of stored and supplemental feed is uncommon. The latest serious feed shortage in the south occurred in October, 1957, when an estimated 10 per cent of the cattle died. Mortality rates of 6 to 8 per cent may be expected during dry years, but a 2 per cent mortality rate is regarded as normal for deaths from all causes.

The potential carrying capacity of much Chilean land is not being realized.* Pastures remain unimproved or non-irrigated in many areas

* The carrying capacity of land is estimated at 0.07 units per acre for unimproved pasture; 0.20 units for irrigated unimproved pasture; 0.26 units for dry-land improved pasture; and 0.9 units for irrigated improved pasture.

where upgrading can be done. The carrying capacity can be increased, too, by barn feeding (soiling). An illustration of the correctable deficiencies in land use is provided in a recent survey of 213 advanced operations in the Santiago milkshed. Slightly over 10 per cent of the collective arable land was in natural pasture, supporting less than 0.2 beef livestock units per acre. Improved and irrigated under the best of local management the land was capable of supporting 1 head per acre.

The feeding of supplements is uncommon. Stock housing and feed storage facilities are modestly developed. In South Central and South Chile only 10 per cent of the operations have barns of any sort.

The year-round dairy operators in the north tend to develop enough stall capacity to stable each milking cow. However, there are operators who prefer to corral milk during the summer; still others have milking performed in corrals the year around. The year-around operators generally milk twice a day, but some reduce winter milking to once a day. Hand milking predominates. Operators who purchase machines often discover that it is difficult to use them because of the unavailabilty of replacement parts.

For the most part, the maintenance of milk handling equipment is modest. Regulatory requirements governing equipment or general sanitation on the farm are not enforced; health service officials fear that 90 per cent of the milk supply might be excluded from the market if the laws were enforced. Even processing plant officials hesitate to impose regulations on raw milk suppliers because the latter may be influential, or because the trade may be lost to a less particular competitor.

Milk Availability

The per capita availability of milk and dairy products is difficult to determine with assurance, but it is rising. It probably did not average above 90 pounds annually in the 1930's. In the 1940's it may have been 135 to185 pounds per year; in 1951-55, according to government estimates, 252 pounds represented per capita availability of dairy products produced in Chile. Prior to World War II, Chile exported dairy products, but the rise in domestic consumption has resulted in a net import since 1946-50. The flow of imports rose to 6.9 per cent of national production in 1954, and 15.5 per cent of production in 1955.

An annual per capita total availability of about 260 pounds of dairy products hardly suggests a true picture of regional or group consumption. Urban areas and the numerically small upper and middle classes are the chief consumers of dairy products. Metropolitan Santiago, where one-fifth of the Chileans live, is the major market. Its cheese and butter supply area includes all of central Chile, and fluid milk is drawn from as far south as Talca. The expansion of the Santiago milkshed has been rapid in recent years.

In 1935 a pasteurization law resulted in the adoption of the use of trucks to carry milk into Santiago. Producers contracted with carriers to deliver to the processors; the processors assumed responsibility for retail delivery. Eliminated were the independent street retailers whose carts formerly carried the raw milk into the city. There is fair evidence that they sold a

lot of irrigation water as well. The pasteurizing law was salutory; for the first time a measure had been adopted that protected the consumer.

As late as 1953, 96 per cent of Santiago's fluid milk supply came from within the province, but by 1957 the province provided only 54 per cent. The change reflected an extension of the milkshed to the Aconcagua Valley, on the north; and, more important, southward to Rancagua, San Fernando, and Talca (150 miles). Although the supply area has expanded it should be noted that beyond a radius of 35 miles the existence of a city milkshed is largely a winter phenomenon. From April to September the peripheral districts make up the city's milk shortage. In the summer, when production is high and when many consumers are out of town, dairy districts near Santiago are able to meet the city's requirements.

Recent Government Policy

Government dairy policy is confronted with the dilemma of satisfying consumer and producer demands in an economy-blighting inflation. Uncertainty about milk pricing policy has discouraged producers and distributors from developing long-range expansion or improvement programs. Milk price controls are rigid, so there are no compensations to producers for rising production costs. Reflecting dairy industry dissatisfaction were a 14 per cent production decline between 1949 and 1950, an 11 per cent drop between 1952 and 1953, and a 2.1 per cent drop between 1955 and 1956. Imported products are used to keep consumers satisfied with prices, but the competition often turns Chilean operators to meat or wheat production.

Official concern over milk scarcity led to the institution of a dairy industry development program in 1948. The program facilitates the formation of producers' cooperatives and provides funds for farm improvement loans and production and management research. The dairy development law further commits the government to a program of processing plant construction. It is the latter activity which finds warmest support among officials.

Conclusion

If the dairy industry were to receive uniformly attractive compensation for enterprise over all of central Chile, the industry might soon become the most important farm activity in the country. Today dairy products represent about 12 per cent by value of all farm production; wheat and beef represent only a little over 15 per cent each of total farm production. The advances in dairy output seem most promising for the Temperate Marine south of central Chile. There, feeding on 40 per cent of the country's arable land (most of it unimproved pasture or browse), is 42 per cent of the Chilean dairy herd. With improved pasture and stock management, and an increase of productivity from the present 2,000 pounds of milk per cow per annum upward to the 3,000-pound national average, this zone would begin to realize its potential as the country's chief dairy region. Eventually it will develop into the foremost dairy region, but there is little evidence that present industry growth rates will alter much. A substantial cash incentive, faith in government policy, and adequate roads are lacking. The gap between production and consumption rates is going to require significant dairy imports for years to come.

TWO WATER FLOW MAPS OF CALIFORNIA

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Maps showing volume of movement have became familiar geographic tools in such cases as highway traffic and ocean trade. Indeed, their value prompts inquiry into other kinds of movements which might usefully be shown on flow maps. Water, logically enough, is one of these, and it is a matter of curiosity that water flow maps for water-conscious California should be so few to date.[1] In view of data available from public agencies,[2] it is suggested here that California's water resources might be portrayed for our students and the general public in a more revealing way by greater use of flow maps.

For example, in place of the usual river map which shows little difference in river size, there might be offered instead a map on which river width is drawn in proportion to actual volume of flow. Figure 1 shows all rivers having an average annual natural runoff of at least 100,000 acre-feet, with line thickness proportional to runoffs exceeding 500,000 acre-feet.

As a teaching device, the map makes tangible the idea that river flows from the San Joaquin Valley and North Coast are oriented away from the parts of California where they are most needed at present. Plainly indicated are the importance of the Delta area as a natural distribution point for man's diversions,[3] and the significance of the relatively gigantic Colorado River to the southern part of the state. The map further suggests the substantial exhange of waters between California and its neighbors, and the resulting political and economic implications of a shared water supply. A glance at this sort of map may prompt basic questions and inspire progress toward their answers; for example: What balance of climate and ground conditions accounts for the runoff pattern? To what degree have river volume and spacing been related to usability? Why did the state select one, and only one, river as a political boundary?

For many parts of California, the larger water flows tend to be the manufactured ones, particularly urban aqueducts and irrigation canals. These cannot be overlooked in making an accurate accounting of California water flow. In contrast to existing maps which show only the direction of river diversions, Figure 2 indicates the relative annual volume of the larger diversions. To permit presentation at this scale, the map is limited

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[1] Perhaps most notable is the map of Central Valley streamflow published by U. S. Bureau of Reclamation, in *Central Valley Basin,* 1949, Plate 10. Average annual runoffs for the larger rivers of California, 1889-1929, compiled originally in the Calif. Div. Water Res. *Bulletin* 25, were reported conveniently in the *Geog. Rev.*, 1939, p. 253.

[2] Outstanding sources of flow data used in compiling the two maps here were: (1) Calif. State Water Resources Board, *Bulletin* 1, 1951, and *Bulletin* 2, Vol. I, 1955; (2) Calif. Div. Water Res., *Reports of Sacramento-San Joaquin Supervision* for 1953 and 1954; and (3) U.S. Geological Survey, *Water Supply Papers* for the Colorado River Basin and Pacific Slope Basins in California. In addition, certain canal data were kindly furnished in a letter from Irvin M. Ingerson, Principal Hydraulic Engineer, Calif. Dept. of Water Resouces, November 13, 1957.

[3] Average annual natural runoff about 30 million acre-feet per year.

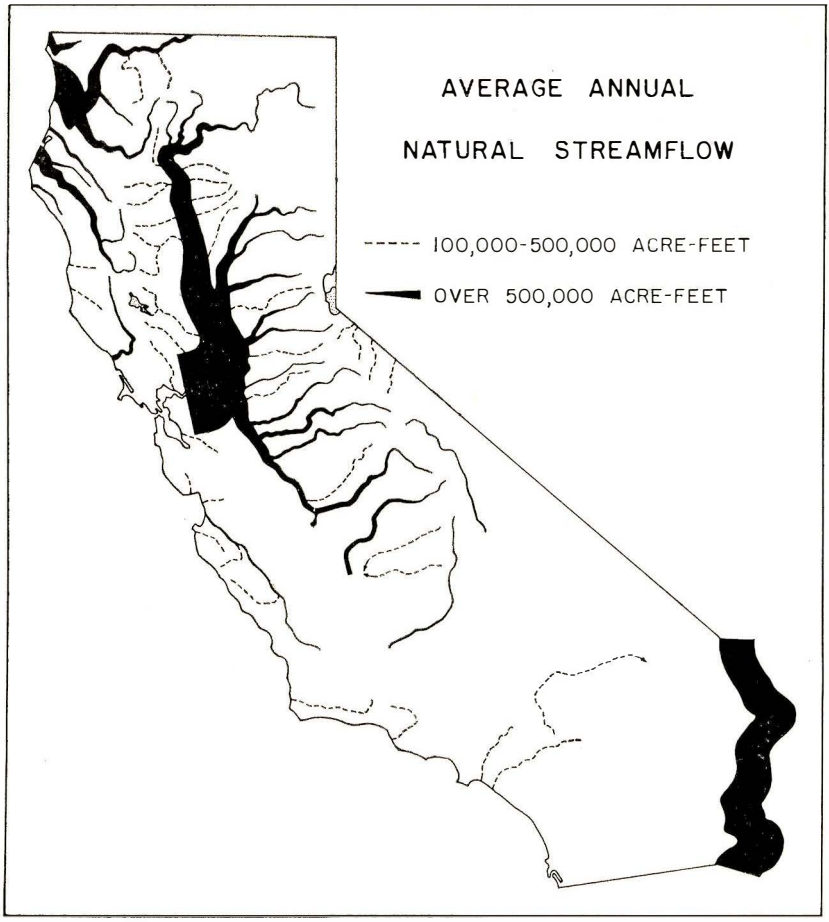

Fig. 1

to major diversions terminating outside the original watershed.[4] These man-made rivers are comparatively new and in many cases are variable; where average annual flow is obviously increasing, recent one-year data were used in place of the historic average annual flow.

[4] Definitions of diversion "outside the watershed" were made here arbitarily, and in part for convenience in presentation. Thus, among the borderline cases included were the All-American Canal and the Glenn-Colusa Canal-Back Borrow Pit-Yolo Bypass system. Excluded were the Sutter Bypass (over 3 million acre-feet annually) and the Delta Cross Channel (over 2 million acre feet annually). Also excluded were numerous short interbasin diversions, none accounting for as much as 50,000 acre-feet annually. These are, in north-south order: Pit River watershed to Madeline Plains, Mad River to Eureka, Little Truckee River to Sierra Valley, Echo Lake to American River, Cosumnes River to American River, Cache Slough to Vallejo, Contra Costa Canal, Mono Craters Tunnel, Salinas River to San Luis Obispo, Santa Ynez River to Santa Barbara area, and Cottonwood Creek to San Diego area. Possibly also

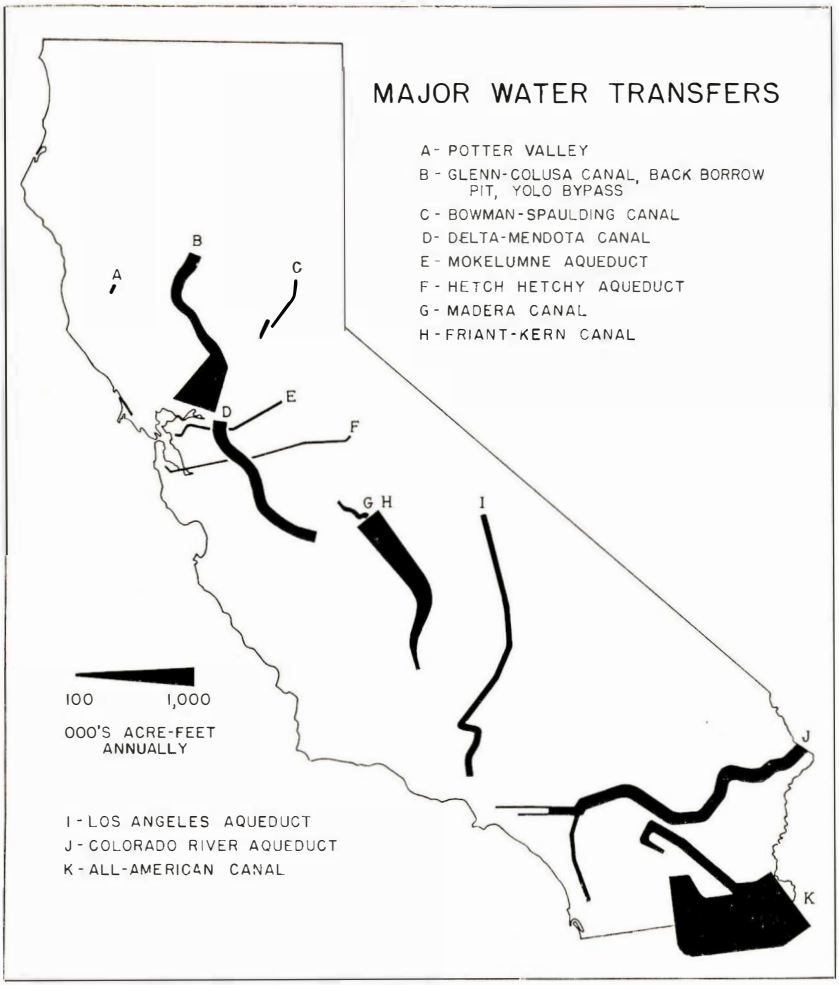

Fig. 2

The largest water diversion shown on Figure 2—one not especially publicized in California—is the All-American Canal flow to Imperial Valley,[5] beside which the South Coast imports from the Colorado River

qualifying for the foregoing list would be flow from Cache to Putah Creeks and from the Kings to the San Joaquin River. It is revealing to note that despite the greater publicity given certain more recent diversions such as the Contra Costa Canal or the Cachuma Tunnel, two of the older and little-publicized diversions—primarily for hydroelectric purpose—actually transfer far greater water volume: the Potter Valley diversion from the Eel River to the Russian River watershed, and the Bowman-Spaulding canal system linking the Yuba and America Rivers (letters A and C, respectively, on Figure 2).

[5] About 3 million acre-feet per year, excluding the Coachella Branch.

and Owens Valley look all but insignificant. In fact, it is somewhat misleading to say that the Colorado River no longer flows into the Salton Basin! Other basic conditions illustrated by Figure 2 include: (1) the near-absence of exports from the North Coast watershed as yet; (2) the magnitude of Owens River diversion, considering dependence on facilities constructed under engineering and financial limitations of an earlier day; (3) the relatively small use as yet of Sierra Nevada water by the Bay Area; (4) the recharge of groundwater reservoirs in the Los Angeles area with imported water, as represented on the map by two prongs extending westward from the terminus of the Colorado River Aqueduct; (5) the complex, but integrated, flow of irrigation, irrigation drainage, and floodwaters along the west side of the Sacramento Valley, and (6) the well-publicized southward water transfers in the San Joaquin Valley.

Certain problems are inherent in constructing water flow maps. The very fact that these maps have far-reaching utility and that source data for them are readily obtained makes it desirable to anticipate such problems. Perhaps chief among them is the matter of scale. The range of flows even within a local area is often so large as to prevent complete portrayal. One alternative is to prepare separate maps of individual kinds of water flow, such as Figures 1 and 2 above. Likewise, there is frequent difficulty in accurately representing both volume and route of flow within a limited space. The use of color permits overlapping of flows to some extent. Where color fails, the technique of "stylizing" the routes of flow is usually successful, so long as there is no attempt to combine stylized flow data with accurate base data, such as city location, on the same map.

More important than the problems are the possibilities of drawing many more and better water flow maps than the two demonstrated here. It is entirely feasible, for example, to create maps to illustrate: (1) interstate water flows, especially complex situations involving the Klamath River, Lake Tahoe, or the Colorado River; (2) integrated schemes of natural and man-made flows, especially in heavily-irrigated valleys,[6] (3) seasonal patterns of water flow, where such matters as wastage, storage, and hydroelectric generation are pertinent. The teacher is urged to consider the advantages of such flow maps, wherein students may visualize both the "where" and the "how much" in one glance.

[6] Due to scale limitations, it was not deemed practical to show local (intra-basin) diversions on Figure 2, despite their huge volume and local importance. Largest of these, according to the author's information, is the Palo Verde Canal, which diverts over 800,000 acre-feet annually. In descending order of annual volume are: Turlock Canal, Merced Canal, South San Joaquin Canal, Sutter Butte Canal, Almanor-Butt Tunnel, Ward Tunnel, Modesto Canal, and Fresno Canal. All of these carry an annual average flow exceeding 300,000 acre feet.

1960
ANNUAL MEETING

The 1960 Annual Meeting of the California Council of Geography Teachers will be held at San Jose State College May 7 and 8.