An outline map of California is centered on the page. The title 'The California Geographer' is printed in a dark red, serif font, with the words stacked vertically and overlapping the map's outline.

# The California Geographer

Annual Publication of the  
CALIFORNIA COUNCIL OF GEOGRAPHY TEACHERS

ROBERT A. KENNELLY, *Editor*

1963

# THE CALIFORNIA GEOGRAPHER

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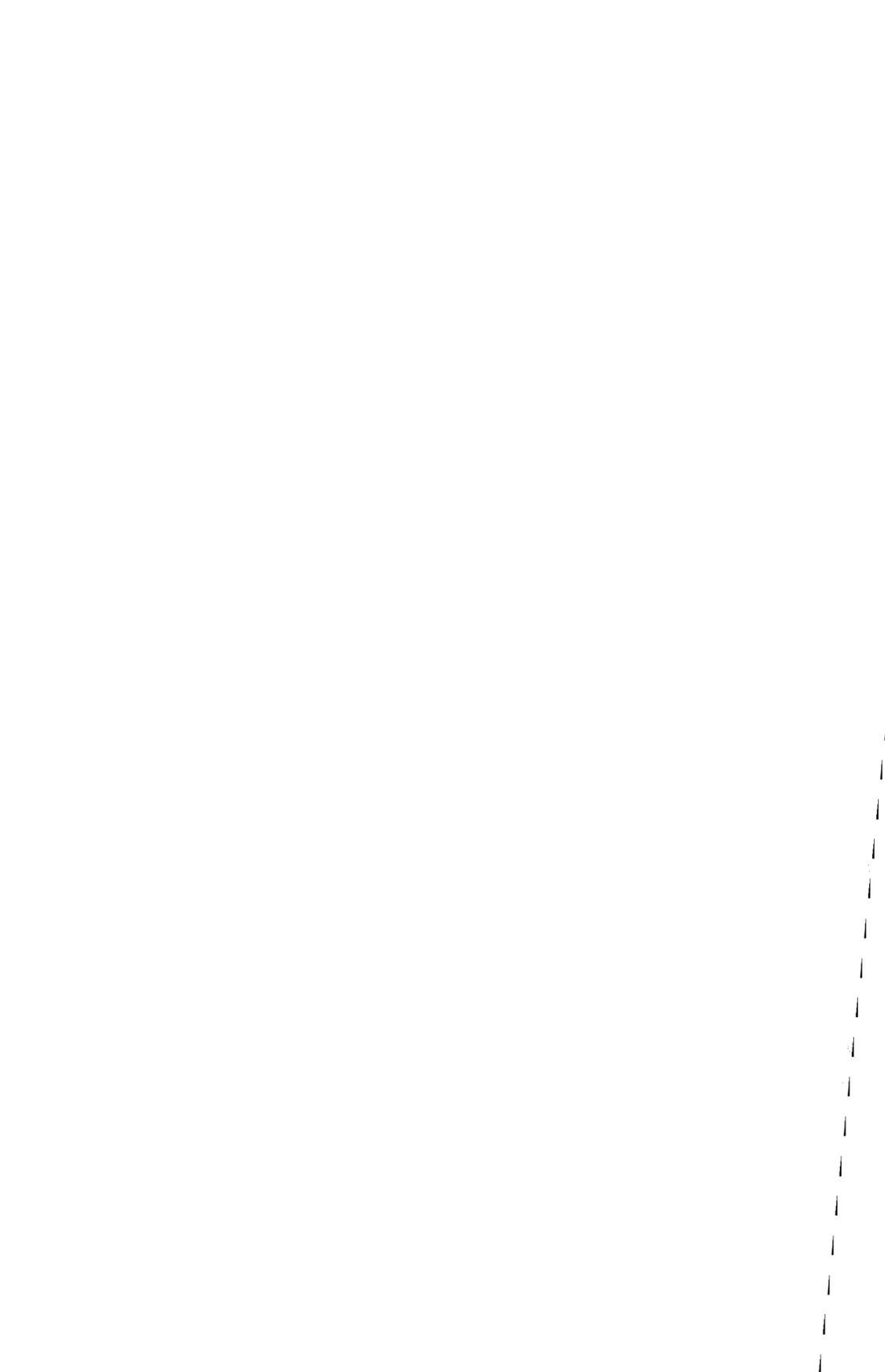
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# BOUNDARIES AND AFRICAN NATIONALISM\*

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National boundaries are assuming critical importance in Africa. My thesis is that emphasis on national boundaries and disputes over them are desirable in the evolution of nationalism on the African continent. This derives from the larger construct that nationalism is an essential political stage in the extension of the rule of law from the clan or tribe to the global level, and it is a prime element in attaining an essential economic stage—what W. W. Rostow terms “the takeoff.”<sup>1</sup> Nationalism is a cohesive force; it could engender the empathy and trust which must exist if individuals and tribes are to pool their talents and invest their resources for mutual benefit by sinking their differences before they sink their newly launched country. A corollary of my thesis is that the emergence of independent states in Africa (and in Asia, to cite the Indian-Goan affair) creates boundary problems of a new magnitude.

It is periodically fashionable to decry boundary issues as anachronistic and nationalism as an inherently evil breeder of war. The critics of African nationalism are usually found in mature nations that have reaped many benefits from nationalism. There was a time when Great Britain and France threatened war over the Fashoda incident, and Americans seeking territorial expansion shouted the ultimatum of “54-40 or fight.” Hypocritical attitudes toward African nationalism will not be discussed, nor will the assumption, which I consider fallacious, that there is a cause and effect relationship between nationalism and dictatorship, although the role of boundaries in a “one party” state will be examined.

In delineating nationalistic attitudes towards boundaries, I am not suggesting that the ontogeny of African nationalism must recapitulate the phylogeny of nationalism developed in Europe. Nationalism as it is developing in Africa has unique qualities; boundaries may play an even greater role in creating a national consciousness there than they did in Europe in the 19th century. Most of the older nationalisms have grown out of the an existent base. In the cases of Meiji Japan and Bismarck Germany, the nationalists had but to rouse an incipient nation to consciousness.<sup>2</sup> This may characterize the nationalism of Nasser's Egypt, the special case of the Jews in the Diaspora, and possibly Algerian nationalism. But it is by no means the pattern of, say, Nigerian nationalism. Sub-Saharan Africa does not fit the traditional mold.

## COLONIAL BOUNDARY MAKING

While it is true that the European map-makers in the decade after 1885 were blithely carving up most of Africa in such a way as to cut

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\* This is the text of the address presented at the Annual Banquet of the California Council of Geography Teachers, Fresno, Calif., May 5, 1962.

<sup>1</sup> This theme is not discussed here but is developed at length in a forthcoming book by members of the American Universities Field Staff (edited by K. H. Silvert) concerning the *Strategy and Study of Nationalism*.

<sup>2</sup> As discussed by Rupert Emerson in *From Empire to Nation* (Cambridge: Harvard University Press, 1960).

many tribes in two, the emphasis on this deplorable aspect of European imperialism has obscured an equally important consequence of the scramble for Africa. European colonial powers were creating political units on a far larger scale than had previously existed in most of Africa. In doing so, they broke up the remnants of some ancient and honorable empires, especially in the West African interior, where they completed a process begun by desiccation. The larger state did have what are called "artificial" boundaries. In fact, 74 per cent of the boundaries currently recognized in Africa were set by drawing astronomical or mathematical lines on a map.<sup>2</sup>

African nationalists inside these colonial-created boundaries can occasionally evoke memories of past glories, as in the case of the former British colony, the Gold Coast, taking the name Ghana from a famous empire which lay some 500 miles north of its present borders. But on the whole there is relatively little common tradition for African nationalists to evoke in the nation-building process. If there were, the nationalists would not have, themselves, denounced the boundaries of their new nations as artificial.

Frequent African complaints against the carving up of Africa by European nations without regard to ethnic or historical considerations were a feature of the decade from 1945 to 1955. As an example, one recalls the repeated appeals to the Trusteeship Council on behalf of the million strong Ewe people living in Togoland and the Gold Coast. The boundaries of Togo were artificially created by Germany in the closing years of the 19th century and existed only until 1914 when Togo was divided between France and Great Britain with only a modicum of attention given to tribal lines. Ewe chiefs protested this division of their people in 1919 and after, but it was not until the United Nations came into being that their petitions received any attention. Thus, the General Assembly in 1950 referred to "the great importance of the Ewe problem," and two years later in 1952 formally requested Britain and France to proceed with Togo unification. In 1956 the United Nations allowed British Togoland to be incorporated into Ghana. Despite the fact that an overwhelming majority of the Ewes voted against unification, they were unable to overcome the desire of northern Togoland to join Ghana.

In recent years, prospects of Ewe unification have dwindled even further. In 1958, on the Ghana border, I heard Minister Krebo Edusei threaten a crowd of Ewes who were asking for self-determination, calling them hooligans, and warning them that as a former hooligan himself, he knew how to deal with them. Relations between Togoland and Ghana have been severely strained by reciprocal accusations of assassination plots and border violations. Problems that the European colonial powers failed to resolve have certainly not been resolved by the independent African states.

Turning to Ghana's border with the Ivory Coast we find a different kind of boundary dispute arising from suspected deposits of oil in commercial quantities. As colonial powers, the French and British felt no need to haggle over the specific boundaries of Ghana and the Ivory Coast near

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<sup>2</sup> Calculated by K. M. Barbour in Barbour, K. M. and R. M. Prothero, *Essays in African Population* (London: Routledge, Kegan Paul, 1961).

the Atlantic Ocean; but Houphouët-Boigny and Nkrumah could conceivably lead their nations to the brink of war over this very issue.

The efforts of the Kameruns movement to establish an African nation within the boundaries laid down by ill-informed Germans half a century ago is an extreme example of utilizing the unifying force of European colonial boundaries in building nations from tribes and of reinforcing the image by utilizing the German spelling of Cameroons.

#### EUROPEAN BOUNDARY CONCEPTS APPLIED TO AFRICA

Many African boundaries were criticized by both Africans and Europeans because they did not fit contemporary European experience. In the heyday of geographical environmentalism Ellen Semple laid down the rule that boundaries rank in the following order of importance: racial, cultural, linguistic, and political.<sup>1</sup> These criteria have limited application in Africa today. Many groups in Nigeria have greater racial affinities with peoples outside the country than within it. Also, in Eastern Africa, the distribution of Nilotic and Bantu people has no reflection in the boundaries as they were drawn.

Miss Semple's second criterion, culture, is most noticeable in two contiguous areas (sav Ghana and the Ivory Coast) which manifest the differences between French and the British versions of Western culture. Such differences raise doubts as to the ability of southern Cameroons, with its British colonial background, to coalesce with the former French Cameroons. In the Horn of Africa the British and Italians made less of an impact on the nomadic Somali societies, and fusion should be easier.

The language factor is less important in Africa than it is in Europe or Asia. The language of African nationalists south of the Sahara is either French or English. Tanganyika is the one new nation in this area with a viable African language, namely Ki-Swahili, fortunately not in the debased form used in the eastern Congo and Uganda, or of the Ki settler of Kenya, but sufficiently close to Arabic to allow borrowings. Thus Tanganyika can look forward to being a Swahili-speaking nation, although both Swahili and English will be used in government and understood by its African, Asian, and European legislators. But Tanganyika is the exception and few national boundaries in Africa are also linguistic ones. Thus three of Miss Semple's criteria have little importance in Africa, and the political factor is dominant.

In 1938, Richard Hartshorne concluded from his study of European boundaries that there existed three associations which "clearly do tie regions together."<sup>2</sup> He named the "cultural character of the population"; the "local communications of people and goods but chiefly those concerned with the economic life of the areas"; and, finally, "memories and concepts derived from a common past, that is, historical associations." An attempt to apply these to contemporary Africa merely underlines the disruptive influence of the short period of colonial control. The economic, political, and cultural associations going back many centuries usually have been out-

<sup>1</sup> Semple, Ellen Churchill, *Influences of Geographic Environment* (New York, Henry Holt, 1911).

<sup>2</sup> Colby, C. C. (ed.), *Geographic Aspects of International Relations* (Chicago: University of Chicago Press, 1938), p. 167 ff.

weighed by those initiated in the last five decades. Transportation, crops grown both for local consumption and for export, languages beyond primary school, and the rudimentary vision of nation beyond tribe are intimately bound up with the heritage of colonialism. Hartshorne's "common memories" (or a common colonial past) are a factor in the emergence of the Brazzaville group binding together such diverse countries as Madagascar and Senegal.

If the importance attached to boundaries results from an early stage of nationalism, we need not, therefore, compare Africa today with the Semple and Hartshorne Europe of the last hundred years, but rather use 17th-century Europe for comparative purposes. Conditions then were not unlike those of Africa today. Europe had an essentially bi-class social system and was undergoing the strain of grouping traditional feudalistic units into larger aggregates of new and uncertain loyalties. The 18th century doctrine of natural frontiers had yet to arise, and, as Sir George Clark has pointed out,<sup>6</sup> European frontiers were still "ill defined, indented, economically and politically inconvenient." The European "*frontiere*" were not lines but areas; until quite recently, this was true of many African frontiers and is still true in some places.<sup>7</sup>

Border disputes play an important role in the extension of national consciousness in that vacuum which follows the achievement of independence. New unifying symbols are so desperately needed and the problem of welding tribes into a nation is so pressing in Africa that any issue which symbolizes the new form of political organization—i.e., the nation—has great pragmatic importance.

#### ONE-PARTY NATIONS

The fact that one-party governments have emerged in nearly all the new African states seems to indicate a common conviction held by their citizens that unity is all important. The Sierra Leoneans hold this belief, although their urge toward national unity has led to a coalition government rather than to the imprisonment of the opposition. The frangible structure of new African nations makes the parliamentary expression of a "loyal opposition" a seeming contradiction in terms. The party in power has a thirst for power that is rarely slaked short of the political boundaries of the new nation. The drive toward national unity, despite certain inequities, has made Ghana more than a collection of tribal states under former British suzerainty and into that part of West Africa controlled by the Convention People's Party. If forms of democratic government dear to the West are mishandled in the process of nation-building, at least a majority of the one-party governments do represent the wishes of the greatest number of their people. That tolerance of minority views may be achieved or, at least, some progress made toward that goal once the permanence of the new nation as represented by its boundaries, is patently evident both internally and externally. The evolution of anticolonial movements into "one-party" states in Africa further intensified the need for unifying

<sup>6</sup> See Chapter 10, "Frontiers," in Sir George Clark's *The Seventeenth Century*, 2nd ed. (New York: Oxford University Press, 1961).

<sup>7</sup> The unsettled nature of Congolese external boundaries is well summarized by Professor S. Reyner of Howard University in the *Duquesne Review*, Spring, 1961.

issues corresponding with the boundaries of the new nation, because of the importance of "interest aggregation" to the highly dissimilar groups coming to power together. As Coleman and Almond have pointed out, "The cohesion of the party is difficult to maintain. In order to avoid divisive issues, decisions are postponed, and policy proposals take the form of diffuse programs selected more for their unifying symbolism than for their effective coping with demands emanating from the society . . ."<sup>8</sup> If the principal integrative forces are 1) one-party government and 2) a consciousness of national boundaries, it may follow that a greater emphasis upon the latter will lessen the pressure for the former.

But this kind of unity was painfully absent in the Congo on Independence Day in July, 1960. Certainly, one reason for the anarchy that followed was a lack of national feeling. Patrice Lumumba was one of the very few politicians with anything like a national vision. The fact that he was a member of a small tribe and came from the least organized part of the Congo, plus the powerful stimulus he received to think in national terms when he attended the All African People's Conference in Ghana in 1958, gave him a national outlook. Just after he became Prime Minister, I asked him whether he was not following the pattern of Belgian colonialism in insisting that the boundaries of the new Congo must coincide exactly with the boundaries as laid down by the Belgians six short decades ago. Despite some annoyance at the question, he made the valid point that he must first unite and develop a nation; then he would think about changing boundaries.

#### COALESCING MOVEMENTS

Now it is true that in focusing the attention of Ghanaians on his attempts to coalesce with other countries, Nkrumah has taken the lead in somewhat contemptuously dismissing the European pattern of nationalism in its over-concern with petty boundary issues. However, I was present at a meeting of Convention Peoples' Party leaders in 1950 when Nkrumah spelled out the need to confine C.P.P. activities to affairs inside Ghana for a period of ten years. While this concern with internal affairs may seem to conform to the old European nationalistic pattern, it also follows the Marxian doctrine that the proletariat in each country must first win the fight with its own bourgeoisie before the unification of Socialist countries can begin.

Subsequently, Nkrumah's spectacular efforts to ignore established boundaries as binding upon newly emergent nations and his attempts to establish links with Guinea and Mali have contributed to his domestic troubles. I view his semi-erasure of the border with Volta as simply an old-fashioned "power politics" move against the Ivory Coast and its hinterland. Nasser's venture in noncontiguous nation-building (the U. A. R.) is further evidence of the inherent difficulties of such an undertaking. As an old saw puts it: Nigeria is that part of Africa served by the Nigerian railway. In truth, Nigeria is part of Africa enclosed by "artificial boundaries." However, now they define an area characterized by a common elite language, integrated systems of transport, agriculture, currency, etc. To

<sup>8</sup> Almond, Gabriel A. and James S. Coleman, *The Politics of Developing Areas* (Princeton: Princeton University Press, 1960), p. 41.

Nigeria, going through an early stage of nationalism, its boundaries are of tremendous importance in physically defining the limits of extra-tribal loyalty until the time when the concept of nationhood and a sense of empathy among its people take sturdy root.

#### SUB-NATIONAL MOVEMENTS

Although political movements of a truly national nature (that is extending to the boundaries of a political unit) have been relatively rare in Africa until this decade, we have seen various sub-national movements. Most of these involve tribal groups. It is not coincidence that two of the most marked movements in Africa are associated with the Baganda and Hausa peoples, both of which came under strong Lugardian influence. At the southern end of the continent one speaks of the Zulu nation but the Zulu word for nation, *umhlobo*, has more of a social than political connotation. In South Africa, where Afrikaner nationalism is the ruling force, *ons nasie* means Africaners and, rarely, colored Afrikaners. But it is extremely difficult for these tribal ethnic nationalisms to maintain themselves in a vigorous, mature form within wider political boundaries. Plans for Bantustans in South Africa are a partial recognition of these difficulties. In the last five years, however, Afrikaner nationalism has begun to mature rapidly. The most marked indication of this is a shift in the area of the most intense loyalty to the concept of Afrikaner nationalism from the upper class to the lower class. Because the lower class is more numerous, this shift means greater voting strength for *Die Nasionale Party*, but the disaffection of Afrikaner leaders in the church, universities and business is particularly marked. The broader concept of nationalism is, in part, a reflection of a three-class social system. The same phenomenon is beginning to characterize Kiganda society. Baganda college graduates consider Uganda their nation and rarely confine their loyalty to Buganda alone.

On the other hand, when tribal boundaries coincide with country boundaries, such as in Swaziland, the coincidence contributes to the continued dominance of traditional tribal rulers over the young educated elite.

I am not unaware that the nationalistic sentiment that can fuse tribes into nations can be used at times as an excuse for brutality. It was painfully evident to me in Abidjan in 1958 that a nation was being born. The indigenous people of the Ivory Coast did not want foreigners filling many of the best jobs in their civil service and controlling much of the retail trade in their capital. The 1958 rioters murdered, raped, and pillaged for almost a week and succeeded in driving more than 7,000 foreigners from their capital. The fact that these foreigners were all French-speaking Africans, from Togo, Dahomey, Guinea, and Senegal made no difference. The people of the Ivory Coast were united regardless of tribe. They had a sense of nation. It was not enough to be an African from West Africa; the Africans had to be a member of a tribe (any tribe) which resided inside the boundaries of the Ivory Coast.

#### EXTRA-NATIONAL LOYALTIES AND SELF-DETERMINATION

The disaffection of the Bakongo tribe—the principal tribe in the Leopoldville area—with the idea of a Congo nation contained by Belgian-drawn boundaries underlay the inability to arouse a Congolese unity and loyalty

at a critical juncture. For years the Bakongo political party, the Abako, had diluted the image of a free and united Congo with the image of a Bakongo nation rising out of the mists of the 14th century when the tribal boundaries embraced much of what is now Brazzaville Congo and Northern Angola. This ambivalence pervaded Bakongo thinking from Joseph Kasavubu on down. Loyalty and discipline might have been forged on a national basis, but the bonds among the various groupings were exceedingly tenuous. With its failure the Congo had to endure anarchy and disintegration. One may think of the Katanga, but its Belgian-drawn boundaries no longer define the limits of loyalty to President Tshombe. Tens of thousands of its Balubas in a state of civil war are evidence of this.

The whole principle of self-determination has become clouded in Africa. Great Britain adheres to it in allowing the southern Cameroons and northern Cameroons to be separated and has tacitly supported Katanga separation from the Congo. But Britain opposes self-determination for Buganda. The United Nations, the United States, and African politicians have been equally inconsistent. There is a strong feeling among African nationalists that Africa must avoid Balkanization, which would weaken Africa's voice politically and impede economic development. Putting aside the new and powerful role of the African nations in the General Assembly, this belief of African nationalists is a valid one. How rapidly is it possible to move from tribe to nation and from a nation whose boundaries were defined in colonial times to wider Pan-African boundaries? We have mentioned the failure of the Egyptian-Syrian experiment, the difficulties of Ghana, Guinea, and Mali, not to mention the continuing tensions in the Rhodesian Federation. In today's Africa it is extremely unlikely that what few nation-building blocks there are will be pushed over to accommodate a new building pattern such as the Bakongo desire.

In conclusion, boundaries have great importance during the early stages of nationalism, and in the case of the independent African states they may make an enormous contribution to their achievement of nationhood. In the process of nation-building they may replace cultural and even economic factors which are only weakly operative in Africa. Because nations are valuable political and economic devices, Africa needs them. But if nations are pasted together heedlessly, such a union could easily come unstuck under pressure. Thus, it should be admitted, that whether or not Pan Africanism is desirable, it is more difficult to attain in a rigid form than some African optimists have believed. Finally, because nationalism has been a worthwhile stage in the West, it behooves Westerners to view the unfolding of African nationalism and what may seem like anachronistic boundary disputes with a large measure of tolerance. If Africa is to be politically stable and the living standards of its people are to be raised, nation-building is a necessary concomitant, and the modern nation must have strong boundaries before it can think of diluting their importance.

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# FREEWAY IMPACT ON THE CENTRAL BUSINESS DISTRICT: THE CASE OF LONG BEACH

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In the United States there is an increasing awareness of a revolution in metropolitan transportation. One outstanding characteristic of this revolution is the construction of numerous freeways to facilitate circulation both between and within urban areas. Wide interest has developed concerning the effect of freeways on cities, which is not surprising since most cities are faced with the prospect of immense and complex freeway systems that will substantially alter existing circulation patterns.

The broad question of "freeway impact" has been the subject of a number of different investigations. For example, attempts have been made to measure the effects of freeways on the city in general, on particular sections of the city, on particular activities within the city, on strips of land use along a freeway, and on small towns.<sup>1</sup> Since it is not possible to consider all those topics in one brief study, the focus here is on one section of the city, the Central Business District (CBD). The main problems to be considered are: first, upon what factors is the measurement of freeway impact upon the CBD dependent; second, what are some of the outstanding findings relevant to freeway impact on the CBD; and third, what were some important downtown changes as they occurred in one middle-sized city (Long Beach, California) after freeway connections were established between the CBD and outlying areas?

## FACTORS INFLUENCING THE MEASUREMENT OF FREEWAY IMPACT

A successful study of freeway impact on the CBD depends upon several factors: (1) the presence of a well developed freeway-CBD combination, (2) a sound research procedure, and (3) the application of measures of Central Business District change that are likely to reflect the influence of a freeway. A closer look at each of these requirements reveals the following facts. First, good freeway-CBD combinations are hard to find, as most cities have freeways either in the planning stage or only partially completed.<sup>2</sup> Despite this difficulty, in order to realize a successful impact study a significant freeway development should have been in existence for several years, and should be located near enough to the CBD for a substantial flow of traffic to have developed between them.

Second, the problem of selecting an adequate research procedure has been met in the past through employment of the "before and after"

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<sup>1</sup> See, Raymond E. Murphy, Robert J. Huhtanen, Paul J. Mika, and Richard E. Preston, *A Study of the Effects of Freeways on Central Business Districts*, (Worcester: Clark University, 1961); Edgar M. Horwood, Ronald R. Boyce, and other, *Studies of the Central Business District and Urban Freeway Development*, (Seattle: University of Washington Press, 1959); William L. Garrison and Marion E. Marts, *Geographic Impact of Highway Improvement*, Highway Economic Studies, (Seattle: University of Washington, 1958); and W. L. Garrison and M. E. Marts, *Influence of Highway Improvements on Urban Land: A Graphic Summary*, Highway Economic Studies, (Seattle: University of Washington, 1958).

<sup>2</sup> Murphy, *op. cit.*, p. 5 and pp. 133-136.

technique. For example, the land use structure and traffic flow pattern, as they existed within the CBD and its immediately surrounding area, are reconstructed for a period prior to public awareness of the freeway route to the district; several years after the freeway is completed, information is compiled for an indential study area, and the changes in land use and traffic pattern are then measured.

Third, the "multiple-criteria" approach to the measurement of freeway impact and CBD change is generally superior to the single criteria approach because in virtually every situation there are at least several indicators of impact which should be studied together. For example, changes in access, in traffic pattern, in land values, in land use, and in general economic trends were all employed in one study of the effects of freeways on CBDs.<sup>3</sup> In addition to these measures others have been employed, such as changes in central retail sales, central office space, banking deposits, employment, park-and-shop revenue, parking meter revenue, number of telephones, zoning, time-distance relationships between the CBD and outlying areas, and the decentralization of certain establishments due to alteration of time-distance relationships.

However, even investigations satisfying the requirements set forth above have largely failed to reveal specific information relevant to the effect of freeways on CBDs. This failure to delve beyond generalities can be attributed in part to a number of problems, among the most serious of which are the indentification of the rival influences effecting change in the CBD, and the assessment of the influence of each rival force on the CBD. In other words, although improvements in transportation may have a marked effect on a city center, there are numerous simultaneous changes occurring within the urban structure which may also have a definite impact. These include interregional migration, defense spending, national market conditions, labor demand, and the multiplying effects of urban growth.

A second problem faced in every impact study is that of the "time lag," or, "How long does it take after completion of a freeway for its influence to appear in the form of changes in the CBD?" For example, it is reasonable to assume that an increase in business within the downtown will not immediately be reflected in the expansion of central business space; rather business might increase over several years before it is reflected in new or expanded establishments.

#### SELECTED FINDINGS CONCERNING FREEWAY IMPACT<sup>4</sup>

Prior to presenting a summary of selected findings from certain studies of freeway impact on the CBD, it must be emphasized that there is little or no evidence which directly relates these findings to the presence of a freeway. However, some of those studies have produced interesting factual information relevant to the problems being considered here.

When a freeway is located near enough to a CBD to bring about a new circulation pattern in the core area, *changes occur in access and in traffic flow pattern*. These might be classified as obvious responses to the com-

<sup>3</sup> *Ibid.*, pp. 2-3, 7-8.

<sup>4</sup> *Ibid.*, pp. 115-120, and Horwood and Boyce, *op. cit.*, pp. 117-126.

pletion of the freeway; however, the responses have been varied. For example, the new freeway may attract substantial through-traffic, making more space available on surface streets for traffic concerned with the CBD. When this happens, the economic position of the district is usually improved even though the total volume of traffic on its streets does not increase. On the other hand, there may occur a marked gain in total traffic; this often represents a movement across the CBD and has little apparent effect on the business of the district.

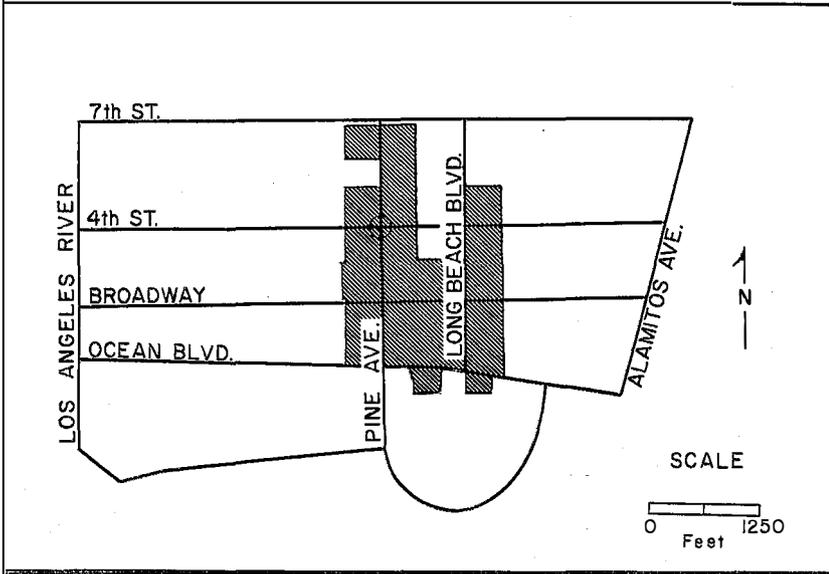


Fig. 1. The "Central Business District" as delimited by the Bureau of the Census (outlined by a solid black line on this map), and the CBD as delimited by Murphy and Others in 1960 (stippled). (After the study by Murphy and Others)

Frequently, freeways are not built specifically to serve the downtown, which explains in part the difficulty of directly relating the presence of a freeway to CBD change. Freeways that only incidentally serve the district are not likely to tie in well with its internal traffic flow pattern, or to be located where they might best serve the major desire lines between residential areas and the CBD.

Investigations of *changes in land values* in the city center have also provided information which might be related to the presence of a freeway. For example, findings based on a limited number of repeat sales indicate that land values tend to have increased more in the CBD than in the immediately surrounding area.

In most CBDs, *changes in land use* have been substantial, the most significant change commonly being the loss of floor space in retail business relative to the gain in floor space by service, financial, and office establishments. Transportation improvements are usually associated with changes in parking space in the CBD (bringing about, in most cases, a net gain).

This is not surprising, as access improvement and parking expansion should be related. Vacancy also appears to have increased considerably in the district. While this may be a result of obsolescence and competition from suburban centers, it could be an ephemeral condition brought about by recent expansion into new buildings. Therefore, in CBDs experiencing overall growth, much of the current vacancy may disappear.

At the present time the zone surrounding the CBD appears to be a more fertile field for the study of freeway impact than the CBD proper. This zone of mixed land use is the scene of accelerated land use change along normal lines, urban redevelopment, and zoning activity. Also, and unlike the CBD with its high property investments and internal linkages which are not usually disturbed by freeway routes, the bordering zone is characterized by lower investments in property and by primarily external linkages which are usually disrupted in some way by a new freeway.

### FREWAY IMPACT AND THE LONG BEACH CBD

Long Beach is a major center of business, finance, administration, and recreation for a substantial part of Los Angeles and Orange Counties. The city proper fronts on the Pacific Ocean in the southern section of the Los Angeles-Long Beach Standard Metropolitan Statistical Area, the second largest SMSA in the United States. Although overshadowed in most urban functions by the nearby metropolis of Los Angeles, and only well known for its convention and recreation facilities, Long Beach has the second largest business center in the SMSA, shares San Pedro Bay with the port of Los Angeles, and has important industrial developments.

Long Beach is served by a relatively fixed network of major arterials, and an expanding freeway system. The Long Beach Freeway, the major link between that city and the rest of the Los Angeles Basin, was planned in 1947. The first major segment of the freeway, opened to traffic in July of 1953, was a one-half mile strip with an interchange at Anaheim Street, several blocks north of the CBD. The connection with Santa Ana Freeway, and hence with the immense freeway system focusing on Los Angeles, came in 1958, but it was not until 1959 that the ramps directly serving downtown Long Beach were opened. Upon completion, the southern portion of the freeway was located parallel to the Los Angeles River several blocks to the west of the city center, and was connected with it by east-west surface streets serving five access ramps (Figures 1 and 2).

The first task is to consider the role of the freeway as a connection between the Long Beach CBD and surrounding areas. Toward this end, it must be pointed out that the freeway was not specifically built to serve the Long Beach CBD, but to improve the connection between the harbor area and Long Beach and the remainder of the Los Angeles Basin. It is clear from Figure 3 that the freeway has made downtown Long Beach and the harbor area more accessible from all those areas served by the Los Angeles Freeway system. On the other hand, the freeway has not improved access to the CBD from the densely populated residential sections of the Long Beach Metropolitan Area. Most of the people within thirty minutes driving time of downtown Long Beach live to the east and northeast of the CBD, and it is in these areas, as is shown in Figure 2, that the

principal desire lines centering on the district originate. Clearly, the freeway does not improve accessibility to the CBD from the east and northeast.<sup>5</sup>

The effect of the freeway on the CBD is next viewed from the standpoint of, "What changes have taken place within the district since the opening of the freeway in 1953?" Changes have been measured in downtown Long Beach on the basis of three different study areas: (1) the CBD as delimited by the Murphy-Vance technique in 1960, (2) the district as delimited by the Long Beach Planning Department in 1959, and

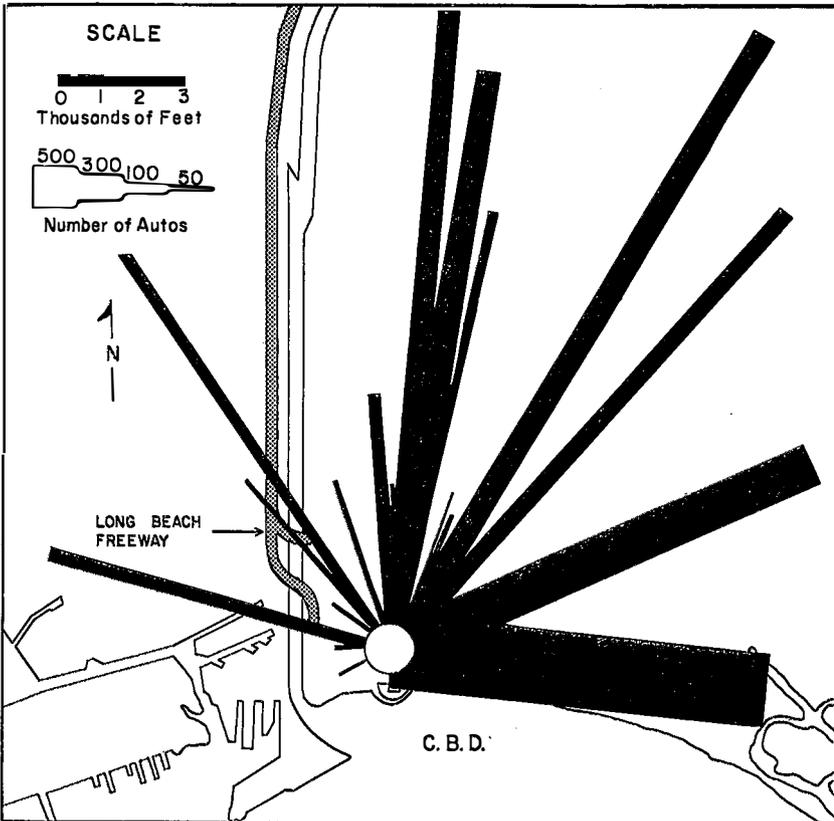


Fig. 2. Desire lines of automobile travel from the Long Beach CBD to areas within the Long Beach metropolitan region. (After report prepared by DeLeuw, Cather and Company)

(3) as delimited by the U.S. Bureau of the Census in 1958. As the first two delimitations were basically determined by the Murphy-Vance technique, and since they are really quite similar, they are not differentiated on the map (Figure 1).

According to the study by Murphy and others, there have been marked changes in access to, and in the traffic pattern within downtown Long

<sup>5</sup> Report on Traffic Distributors in the Central Area: Long Beach, California (Chicago and San Francisco: De Leuw, Cather and Company, 1953), pp. 1-4.

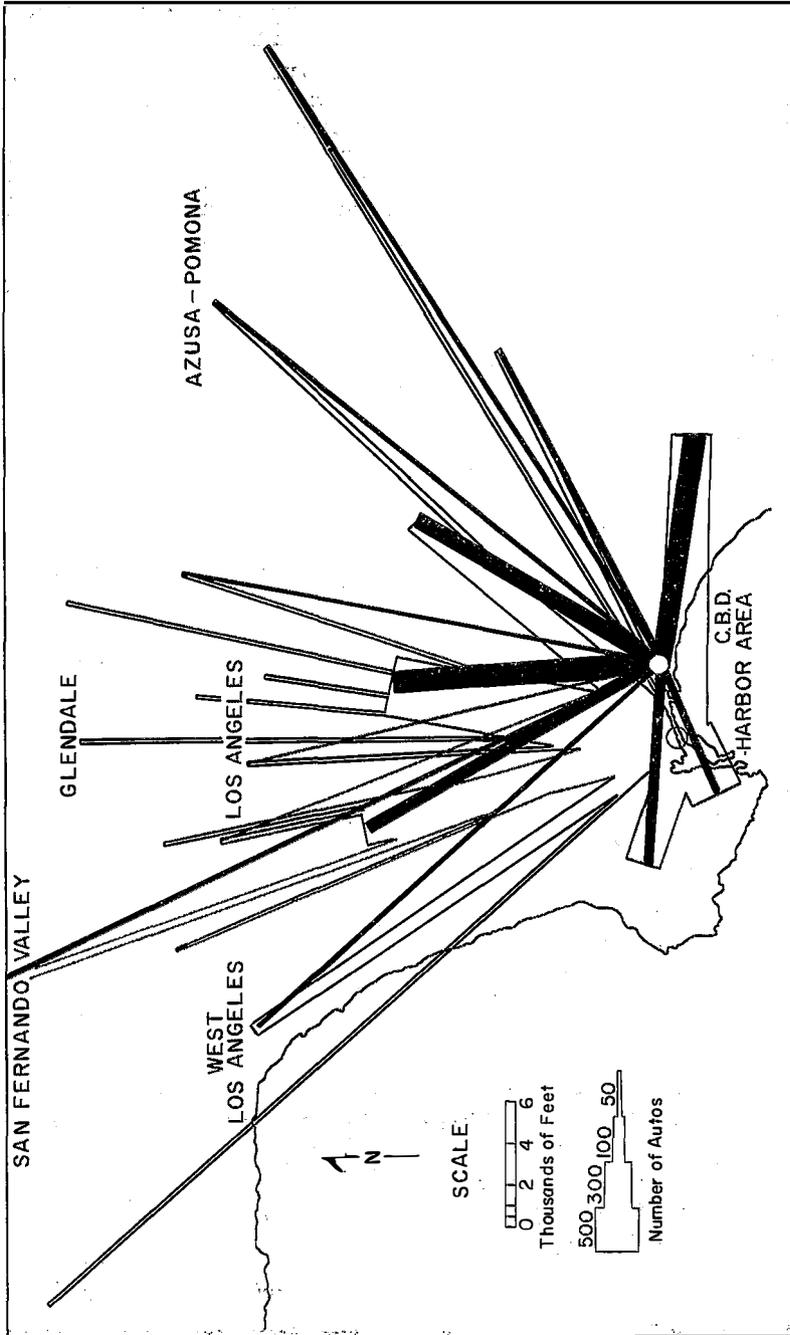


Fig. 3. Desire lines of automobile travel from the harbor area and CBD to areas beyond the Long Beach metropolitan region. (After report prepared by Deleuw, Cather and Company)

Beach, which reveal that even though the freeway was not built specifically to serve the CBD, it has strongly effected its circulation pattern.<sup>6</sup> It was shown that traffic within the CBD increased approximately 20,000 vehicles on an average week day between the pre-freeway (1953) and freeway (1960) study periods. However, this did not automatically mean an increase in CBD business, but only that more cars are passing *through* the CBD to reach the freeway. Also revealed was a major reorientation of traffic within the CBD, with the north-south streets showing a pronounced loss in traffic and the east-west streets showing substantial gains, especially those with direct access to the freeway.

The most outstanding aspect of *land use change* in the CBD, according to Murphy and others, was the expansion in floor space occupied by service, office, and financial establishments relative to the loss in floor space occupied by retail business, plus 32 per cent and minus 6.7 per cent, respectively. Increased office space was particularly important, and parking, which has been considered as an important variable in the assessment of freeway impact, gained significantly, both in number of lots and in total floor space. A marked increase also occurred among the atypical land uses in the CBD, such as: residential, public and organizational, industrial, wholesale-storage, and vacancy, a total increase of 9.2 per cent. In the Murphy-Vance CBD, as a whole, total floor space increased 12.8 per cent, and the types of land use they considered typical of the district increased 14.0 per cent. However, it should be pointed out that one large office building accounted for over half of the increase.

Specific land use changes in the CBD delimited by the Long Beach Planning Department (an area slightly larger than the Murphy-Vance CBD), revealed that between 1948 and 1959 there occurred a 13 per cent decrease in the number of offices, but that during the same period a substantial increase in office space took place, which indicates that although there are now fewer offices in the CBD, those remaining actually occupy more floor space.<sup>7</sup> Also, while the CBD proper was experiencing a decrease in its number of offices, the area immediately surrounding it was undergoing a 115 per cent increase.

It was commonly felt that vacancy was increasing rapidly in the CBD, but a recent study by the Long Beach planners shows that no sizable increase has taken place during the last twelve years. In fact, it was shown that in 1948, total vacancy was 5.2 per cent in the district, while in 1961 total vacancy was 7.1 per cent, a very slight increase for twelve years.<sup>8</sup>

*Changes in land values*, although based on a limited number of repeat sales, revealed that on the average, the price of the second sale was 73 per cent higher than the initial price. There were too few transactions to establish a significant trend, but there was nothing unusual about the

<sup>6</sup> Murphy, *op. cit.*, pp. 63-89.

<sup>7</sup> Part I, *Basic Research for the Central Business District, Long Beach, California*. A Report Prepared by the Department of Planning (Long Beach: The City of Long Beach, 1961), p. 34.

<sup>8</sup> "The Economic Effect of One-Way Streets on Downtown Long Beach, Prepared by the Long Beach City Planning Commission" (Long Beach; August, 1961) pp. 7-8. (Mimeographed).

sample properties that would explain why they would increase in value more than other properties in the CBD.<sup>9</sup>

*Changes in business activity* caused by any single factor, such as a freeway, are difficult to isolate and measure; however, sound statements concerning changes in the CBD's economy can be developed from the observation of several indicators of business activity (Table 1).

Indicators of Retail Business Activity in the Long Beach CBD*			
	1948	1954	1958
Number of Retail Establishments	561	654	598
Retail Sales in CBD	\$ 121,686,000	134,075,000	120,519,000
GAF Sales in the CBD	\$ 82,150,000	72,260,000	66,720,000

**Table 1.**

\* (1) The Central Business District, as defined by the U. S. Bureau of Census, bounded by Seventh Street, Alamitos Avenue, Pacific Ocean and Los Angeles River Channel (See Figure 1).

(2) All data in this table are from U. S. Census of Business (1948, 1954, and 1958).

(3) All data adjusted to 1958 dollars by U. S. Department of Labor Consumer Price Index.

It would appear from Table 1 that the 1958 decrease in retail activity in the Census CBD was indicative of a downward trend. However, 1958 was a year of nationwide recession which reduced retail sales as well as other activities. It has been estimated that if no recession had occurred, retail sales in the CBD could have been approximately ten per cent higher, which would have been a substantial increase over the 1954 figure. In addition, when CBD retail sales are taken over a longer period of time, it is seen that, in terms of 1958 dollars, sales in the CBD only declined about one per cent between 1948 and 1958 despite the recession and tremendous competition from surrounding business centers. The fact that retail sales in the CBD remained level during this period rather than suffering a severe decline is amazing, as most CBDs in the country showed a decrease in total retail sales over the same period.<sup>10</sup>

General merchandise (G), apparel (A), and furniture (F) sales (the GAF group) are thought to be assuming a proportionately greater importance in the CBD.<sup>11</sup> This assumption is based on the fact that despite the decentralization tendencies currently affecting the CBD, the GAF group becomes increasingly important as city size increases. In the Long Beach CBD this is not the case as GAF sales dropped more than total retail sales (Table 1), which may imply that this CBD's strength lies in the diversity of its activities.

Data for CBD park-and-shop and parking meter revenues provide other accurate indicators of downtown business activity, since both of these measures reflect the number of cars parking downtown, thus giving a

<sup>9</sup> *Ibid.*, pp. 9-10

<sup>10</sup> *Ibid.*, pp.

<sup>11</sup> Horwood and Boyce, *op. cit.*, pp. 36-38.

good indication of the number of shoppers, tourists, clients, conventioners, and employees entering the CBD.<sup>12</sup> Between 1954 and 1957 park-and-shop revenues rose abruptly in response to expanded parking facilities and increased ticket validations; over the same period the number of drivers using the meters on the streets declined. However, in 1957, meter revenue reversed its trend and again started upward despite the recession, at the same time park-and-shop revenues declined somewhat. This post-1957 up-swing in meter use is explained by the closing of a major user of park-and-shop in 1958, a five cent raise in rates on validation tickets, and changes in the location of validation desks in stores. On the whole, however, combined parking revenues for the CBD show a significant increase. Another indicator of overall business activity is the number of telephones in the CBD; these had maintained a constant level since 1955, but showed an increase in 1960.<sup>13</sup>

In summary, the main effect of the Long Beach freeway has been to improve the connection between the entire Los Angeles Metropolitan Region and downtown Long Beach and the Harbor area. As the freeway was not specifically designed to serve the Long Beach CBD, its impact on that district has been indirect, and thus difficult to assess. Nevertheless, changes have taken place within the CBD, for example in the overall size and structure of the district itself. Growth in size was characterized by more rapid expansion in the floor space occupied by service, financial, and office uses than in floor space occupied by retail business. There have also been notable changes in parking space. However, these changes are going on in most CBDs. On the other hand, daily traffic has increased in the CBD (especially on the east-west streets connected with freeway access ramps), the traffic pattern within the district has definitely been reoriented, and not only did downtown Long Beach suffer less from the nationwide recession in 1958 than most cities, but parking revenues and other indicators showed definite growth tendencies. To what extent the foregoing changes can be attributed to the coming of the freeway is not known, but since they have definitely come about since its completion, a relationship of some type is possible.

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<sup>12</sup> "The Economic Effect of One-Way Streets on Downtown Long Beach, Prepared by the Long Beach City Planning Commission," p. 5.

<sup>13</sup> *Ibid.*



# CALIFORNIA AIR TRANSPORT

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The purpose of this paper is to show how the utilization of commercial air service by Californians is reflected in the pattern of intrastate routes and in the traffic frequencies of these routes.

Figure 1 is based on the May, 1962, issue of the *Official Airline Guide*<sup>1</sup> and includes all scheduled service by common carriers, except that it does not include helicopter service in the Los Angeles and San Francisco areas. The intrastate flights flown as segments of international routes by Pan American Airways and foreign flag carriers, which have no traffic rights within the state, are not shown either. Routes from California points to out-of-state points are shown only from localities other than Los Angeles, San Diego, and San Francisco.

The routes illustrated on Figure 1 are operated by 6 trunkline carriers, 3 regional carriers, and 2 intrastate carriers. In general the routes with frequencies greater than 28 flights weekly are operated by trunkline carriers, and those with 28 or fewer flights weekly by regional and intrastate carriers.

Frequencies vary greatly between different sections of the state, and the contrast between the highest and lowest route frequencies within California is the greatest within any state in the United States. The greatest frequencies are between the Los Angeles and San Francisco metropolitan areas with 289 flights in each direction. In contrast to this, many routes in the state have only seven round-trip flights weekly.

The Los Angeles, San Francisco, and San Diego areas generate the greatest number of flights. The Los Angeles area alone generates more than 850 intrastate flights weekly out of the Los Angeles, Burbank, Van Nuys, and Long Beach airports. This means a take-off or landing every three minutes and does not include the interstate or international flights which form the bulk of the traffic. In contrast to the metropolitan areas, some of the smaller cities in the state, such as Chico, are served by less than 21 flights weekly.

What are the factors which are important in determining the route and frequency patterns shown on Figure 1? The most important, and most obvious, is population distribution. There is a definite correlation between the pattern of routes and a map of population distribution. The sparsely settled mountain and desert areas have few routes in contrast to the coastal and central valley areas.<sup>2</sup>

Population distribution not only influences the location of routes to a great extent, but it also influences the frequencies of flights on those routes. In general, the population of terminal cities influences route frequencies more than any other factor. For example, the Los Angeles-San

<sup>1</sup>American Aviation Publications, Inc., *Official Airline Guide*, Vol. 18, No. 8. (Washington, D.C.: American Aviation Publications, Inc., 1962).

<sup>2</sup>Edward J. Taaffe, "Air Transportation and United States Urban Distribution," *Geographical Review*, Vol. 46, No. 2 (April 1956), pp. 222-223.

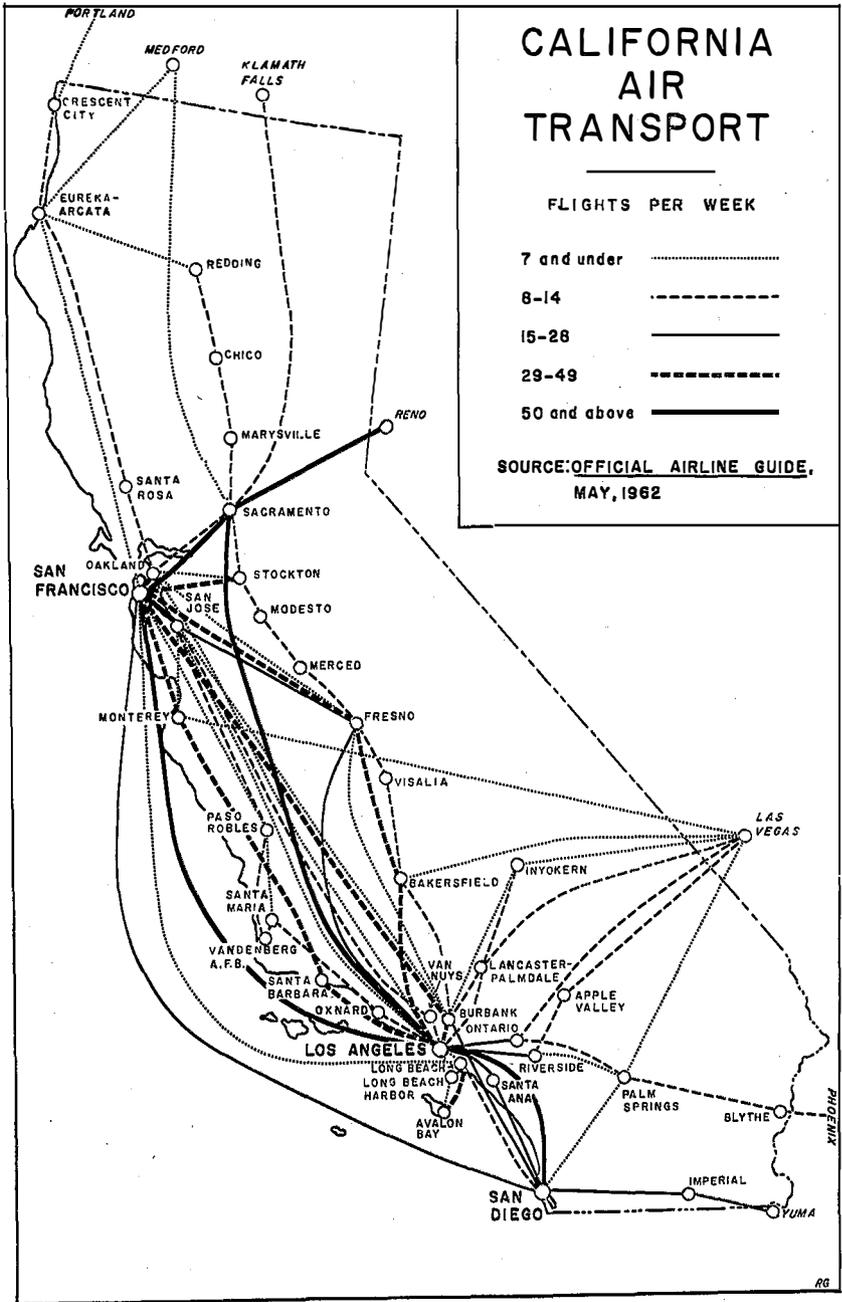


Fig. 1

Diego and Fresno-San Francisco routes have approximately the same lengths and functions, but the former route has a much higher frequency because of the larger populations of the terminal cities.

Population distribution, however, is not the only factor governing route and frequency patterns. Places such as Glendale, Richmond, and San Bernardino, all of which have large populations, do not have air service. This draws attention to the phenomenon known as traffic shadow. Traffic shadow is the tendency of one city in any cluster of cities to act as the air traffic receiving point for the entire cluster.

Traffic shadow is prevalent in many areas of the state but is most apparent in the three large metropolitan areas. There are three types of traffic shadow, none of which is necessarily exclusive of the others in any given city, and examples of all can be found in California. The most important may be termed "absolute" traffic shadow, and exists when the city or cities over which the shadow is being cast have no air service. For example, the Ontario and Riverside airports cast an "absolute" shadow over San Bernardino. Other examples include the Los Angeles, Burbank, Van Nuys, and Long Beach airports which cast an "absolute" shadow over all the other cities in the Los Angeles metropolitan area, and the Imperial airport, which casts an "absolute" shadow over El Centro and Brawley.

The second type of traffic shadow is "partial" traffic shadow, and this exists when one airport casts an imperfect shadow over another airport. In other words, the more important airport will draw some, but not all, of the traffic away from the less important airport. The airport over which the shadow is cast will have routes to many of the same points the more important airport does, but not to all of the points. For example, San Francisco and Oakland cast an "absolute" shadow over all of the other Bay area cities, but San Francisco casts only a "partial" shadow over Oakland. The Los Angeles airport casts a "partial" shadow over the Burbank, Van Nuys, and Long Beach airports.

The third type of traffic shadow, and the one most poorly represented in California, can be termed "reciprocal" traffic shadow. This exists when cities which are within range of each other's traffic shadow have routes to different cities. The only example in California is the traffic shadows of the Los Angeles and Long Beach airports. Long Beach has a route to Avalon Bay, which Los Angeles does not have, but there are many places to which Los Angeles has routes which cannot be reached from Long Beach.<sup>3</sup>

Special city functions also play an important role in both route distribution and frequency. The most striking case is Inyokern, a small town of about 500 people in the Mojave Desert, whose population could not possibly justify air service except for the fact that Inyokern is located adjacent to a naval testing installation. The military function is also present in routes to Lancaster-Palmdale, Oxnard, Vandenberg AFB, Van Nuys, and, possibly, Apple Valley. Deactivation of military installations at or near these places would probably cause a decrease or even abandonment of air service.

A resort function is a substantial stimulus to California air service. The most obvious case is the route from Long Beach to Avalon Bay, which

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<sup>3</sup> William L. Thomas, Jr., with the assistance of Richard Gates, *Pacific Air Transport*, (Pt. Mugu: Pacific Missile Range, 1960).

serves an almost entirely tourist traffic. This resort function is also present in routes to Palm Springs, Apple Valley, Monterey, and Santa Barbara.

Another factor which is important in the establishment of air service to a few of the smaller towns in the state is route position. Places such as Blythe would not have air service if it were not for the fact that they lie on routes between major cities; for example, Blythe has air service because it lies on the route between Los Angeles and Phoenix. If the Los Angeles-Phoenix route did not exist, Blythe could not generate enough traffic to justify a route of its own from either of the terminal cities of the present route. If Needles were in a similar route position as Blythe, it would probably receive air service.

What are some of the unique characteristics of air transport in California? One of the most striking, when comparing Figure 1 with air route maps of other parts of the world, is the absence of places with service of less than fourteen flights weekly. The reason for this apparently lies in the alternatives which are available to the California air passenger. For example, a businessman living in Crescent City who must travel to San Francisco will take the plane if he can return the same day or early the next morning. If, however, the route were operated only three times weekly, travel by automobile or bus would actually be faster for him. This explains why such places as Lone Pine, Bishop, and Alturas do not have scheduled air service by certified carriers. They could all probably generate enough traffic to support a route which had a frequency of three flights weekly, but such service would attract no commercial traffic. It must be noted that many of these smaller places do have scheduled air taxi service and this is a partial substitute for common carrier service.

An attempt has been made to present the patterns of California air transport as they exist today and some of the geographical bases for these patterns. It should be emphasized that these patterns, and their underlying causes, are not static but in a constant state of change.

# FALEAPUNA, A SAMOAN VILLAGE

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Social anthropologists have done much reporting on the aspects of primitive village life that are of concern to them. Geographers have done little. The following paper is offered as a study in village geography—micro-geography, necessarily—revealing the patterns of communal and individual use of land and of water within the village area.

Faleapuna is a small agricultural village on the north coast of Upolu Island, the principal island of Western Samoa.<sup>1</sup> It lies about fourteen miles due east of Apia, Samoa's capital and largest town, and occupies the eastern half of a short straight stretch of coast between two broad bays, Salua-fata Harbor on the west and Falefa Harbor on the east (Figs. 1 and 2).

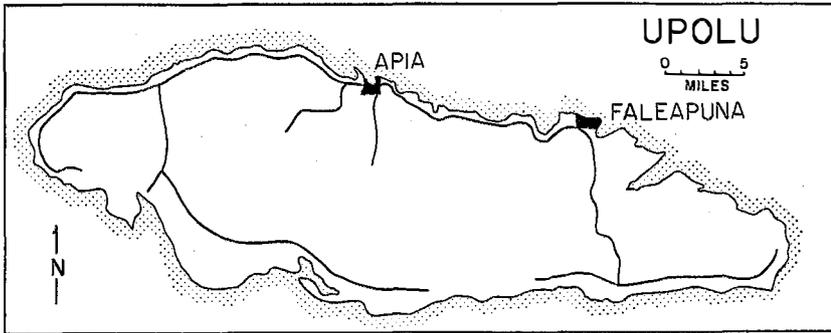


Fig. 1. Upolu Island, Faleapuna Village and its relation to Apia and the island road system.

A coral reef, one mile wide, fringes this part of the island's coast. Much of it shows dry patches at low water (tidal range is about three feet), but immediately along the shore a slightly deeper stretch, one hundred yards in width, provides passage for small boats from one bay to the other.

From the shore a belt of coral debris extends inland for two hundred to four hundred yards to the low bluff marking the edge of the island's volcanic interior. On this coral lowland shallow lagoons with adjoining areas of marsh drain into the sea through narrow outlets. The lagoons, lake-like in appearance, are tidal and brackish.

The volcanic bluff, twenty five feet high in the western edge of the village but lower as it swings east and south, is the seaward edge of the low, flat plain of the Falefa River, which flows into Falefa Harbor.

The surfaced road that follows the coast from Apia winds through the inner part of the village on the edge of the bluff, but here at Falefa Harbor it turns inland along the left bank of the river to climb Mafa Pass and reach the south side of the island.

<sup>1</sup> Faleapuna was not selected because of its particular characteristics. Rather, the author, finding himself there on other business over the course of a year, took advantage of the opportunity to make this study.

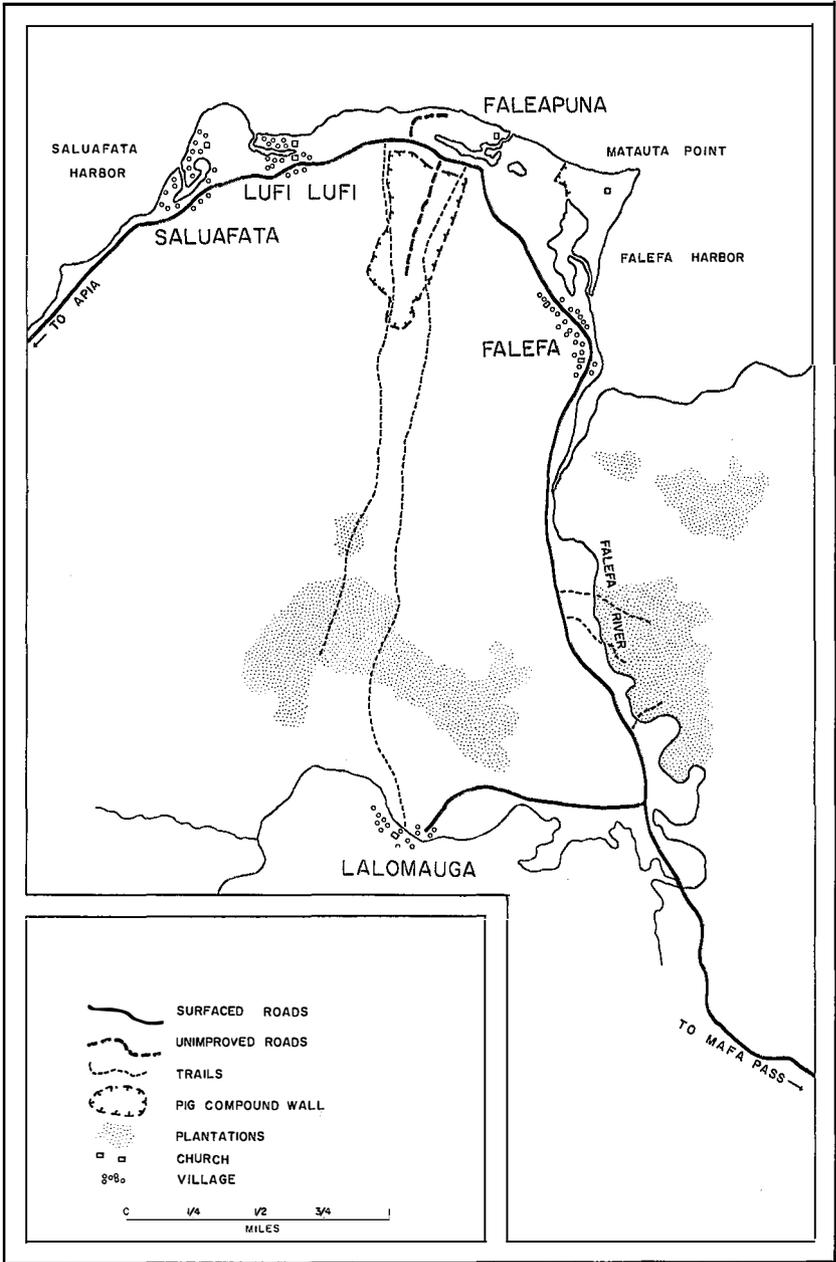


Fig. 2. Vicinity map. Faleapuna plantation lands and neighboring villages.

The greater part of the village is on the coral lowland, the remainder along the road on the edge of the bluff. Four sections, or *pitouu'u* are recognized within the village, each with its proper name, its array of houses, and its own *malae*, or cleared area for ceremonies and games.<sup>2</sup> From west to east the first three, Falepoulima, Sapulu, and Salimu, adjoin one another, while to the east—beyond a half mile stretch of unoccupied land—lies Matautu on the point next to Falefa Harbor.

The forty-five families of the village<sup>3</sup> occupy homesteads consisting usually of three native structures: a round house or guest house (*fale tele*), to its rear a sleeping house (*fale o'o*), and a small cooking hut (*fale umu*). Most of the homesteads are on the stretch of coral sand between the shore and the lagoon-marsh area. Others occupy higher sites along the road, as do a few western style structures, namely, the Pastor's School the three stores, and the cinema (Fig. 3).

The Samoan house, or *fale*, is an attractive structure, oval in shape, with a high "beehive" thatch roof supported by posts set on a raised stone platform. The guest house, in particular, is kept in first class order, while the more utilitarian buildings of each homestead are located inconspicuously several yards to the rear.

An occasional home is located on a site isolated from others, but most of them are grouped around the four *malae* or strung along the trail that parallels the shore. Seldom are the houses closer together than fifty feet, however, and those fronting on the *malae* are usually aligned. The cleared *malae*, approximately football field size, are grass covered and are kept trimmed and cleared of fallen leaves. The village presents a neat and spacious appearance.

Unightly latrines lining the shore—crude scrap-lumber shacks built over the water and reached by short piers—are the only blemish on this otherwise idyllic scene.

Center of population in the village, and also its principal social and recreational center, is the *malae* of Sapulu containing the Government School, the favorite cricket pitch, and the dominant church, that of the London Missionary Society. Falepoulima, reached by a short unimproved road from the highway, contains the chief's home and his *fale tele* which is the official guest house of the village, and was also the site of the Methodist Church before it was razed in 1954. Fronting on the *malae* of Matautu is the Roman Catholic Church.

The churches are western style buildings constructed of whitewashed coral limestone with corrugated metal roofs. Distribution of the village population by religious preference shows no apparent correlation with

<sup>2</sup> *Malae*, although related to the Tahitian *marae*, does not have the religious significance of the latter.

<sup>3</sup> Family, as used here, refers to a single family unit, not to the Samoan *aiga*, or clan, with its elected *matai* chief, a group which may include several biological families. Traditionally about forty *matai* names belong to the village, although currently only thirty-three are represented. Total population in 1951 was 343—185 males and 158 females. Most of the north coast settlements including both of the neighboring villages, Falefa to the south with 747 inhabitants and Lufi to the west with 629, were much larger. *Population Census*, Government of Western Samoa, (Wellington, New Zealand, 1954).

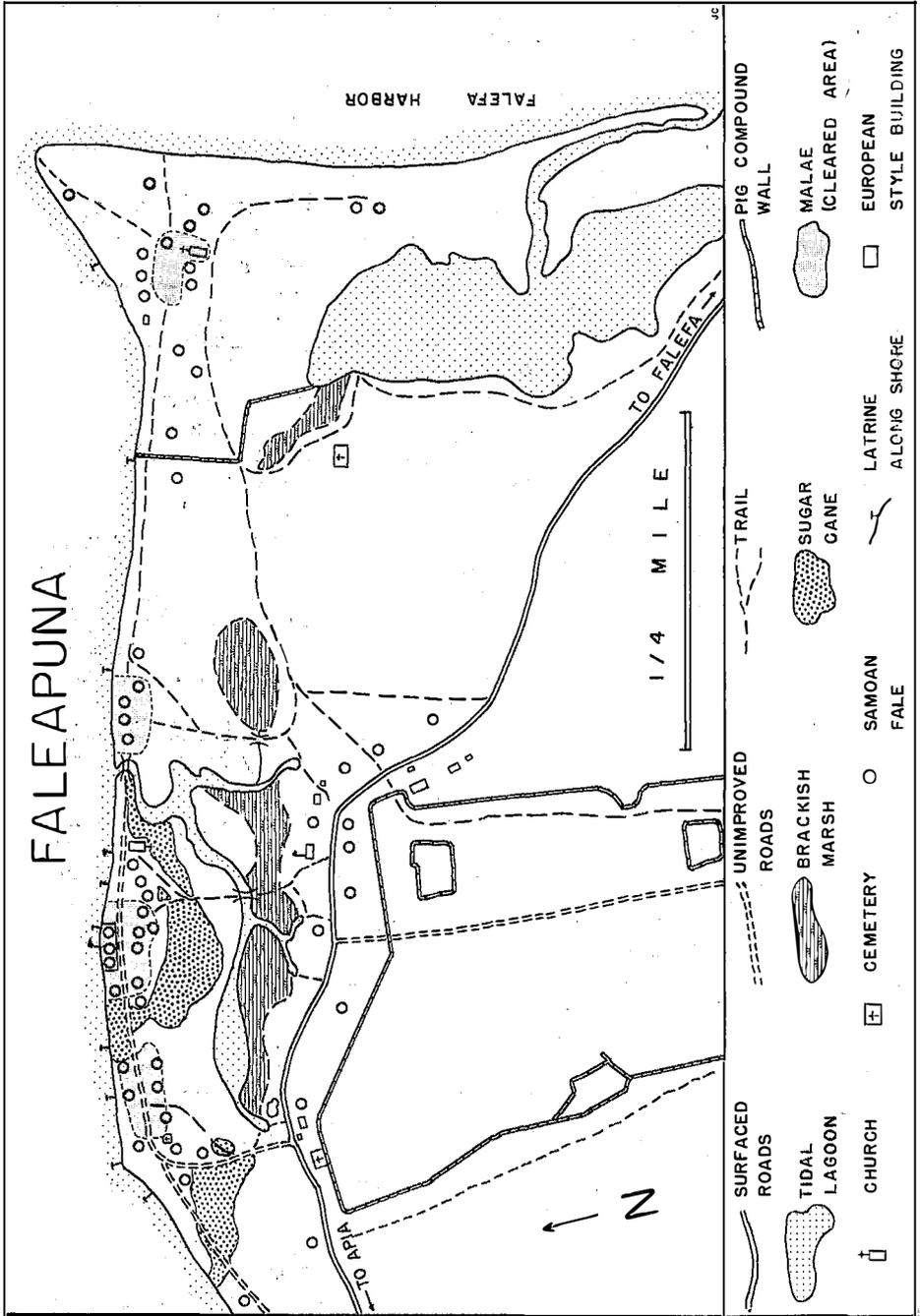


Fig. 3. Faleapuna village.

location of the churches, although the Protestant and Catholic cemeteries are located in the corresponding ends of the village.

The Government School, which must be attended for four years by all children of the village, consists of three Samoan *fales* on the shore. There they are taught the "three R's" in the English language, although Samoan songs and dances are not neglected. In fact classes seem to be held on the adjoining *malae* as frequently as in the school buildings. In addition, the Pastor's School, an important village institution, is attended by the children of all families of the London Missionary Society Church, as well as by a few others. Since most families are L.M.S. adherents, the Pastor's School is also a popular social center.

Along the foot of the bluff are several springs feeding streams that flow into the lagoons.<sup>4</sup> Stones have been laid around the springs to form small pools one yard across that are used for drinking water. These feed into larger stone-rimmed pools used for bathing and for laundry. With one exception, all are tidal and hence salty at high tide. The one exception, the spring below the pastor's house, is used for drinking water only.

Ordinarily the households make use of the spring within their own section, but they are not so restricted. All are free to use the one fresh water spring when the tide is high, and they frequently do so regardless of how remote their homes may be. Matautu people also have access to a nearer spring in the neighboring village of Falefa which is always fresh.

Likewise the families of each section of the village customarily use the bathing pool within their own area. There are no restrictions on the hours at which pools may be used for laundry or for bathing, nor are there regulations separating the sexes.

Each of the pools and springs, like the four sections of the village, has been dignified with a proper name. Vaialae is the pool for Falepoulima; Punalei, the one for Sapulu and the residents along the road. Levi, used for drinking water only, is in Sapulu and is their special claim but may be used by anyone when needed. Apo'a belongs to Salimu, and Punapuna to Matautu.

Although fishing in the lagoons and the sea is important, Faleapuna is principally agricultural, producing within the village and in the nearby farms various subsistence crops and three cash crops: copra (the dried meat of the coconut), cocoa, and bananas. Scavenger chickens and pigs are owned by every family. The chickens run freely about the village, but by law the pigs must be confined and are enclosed in walled compounds, within which other land use is limited. The location of these compounds is important in understanding the layout and functioning of the village, hence its introduction early in this description.

On the inner side of the road, extending inland for one half mile, is a large compound surrounded by a four foot wall of crudely fitted stones. In it roam the one hundred pigs owned by the families of the three western

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<sup>4</sup> The explanation of the springs "presumably lies in the abundance of relatively young lavas . . . which allow water to percolate freely owing to the abundance of vertical cracks and horizontal hollows which are general features of recently-cooled pahoehoe lavas." J. Allan Thompson, "The Geology of Western Samoa," *New Zealand Journal of Science and Technology*, Vol. 4, 1921, pp. 49-66.

divisions of the village. The fourth, Matautu, is itself an enclosed pig compound with a wall crossing the point of land from the lagoon to the sea (Fig. 3).

Still farther inland are farms that produce much of the food and nearly all of the cash crops. Although known as plantations, they are not such in the usual commercial sense but contain instead small plots of mixed plantings owned and worked by individual families, on some of which are grown commercial crops, on others, food for home use only.

Agricultural patterns differ considerably in these areas—the village proper, the pig compounds, and the plantation lands.

In the village there is a great variety of crops, although the only ones found in quantity are sugar cane for roofing thatch and bananas and coconuts, which, since they are required daily, are associated with every homestead. Coconuts grow everywhere except in the cleared *malae* areas and the immediate vicinity of dwellings where falling nuts and branches would constitute a hazard. Near each cooking hut grows a clump of bananas, and a small grove is found on the higher ground near the road. Each homestead likewise has a few pandanus trees, the leaves of which are used for weaving mats, and is likely to have some bamboo.

Scattered throughout the village without apparent pattern, although each is the recognized property of some family, are breadfruit, mango, paw-paw (papaya), and lime trees. There are in addition small clusters or individual plants of coffee, kava, cinammon, and manioc.

Non-food trees include the *niu'afa*, the coconut that produces the husk used for sennit cord; the candlenut, the kapok, the paper mulberry, and the *moso-oi'*, providing fibre for kava strainers. The most abundant non-food plant is sugar cane. Needed frequently for roof thatch repair, and bulky and heavy to carry, it is grown entirely in the village rather than on the plantation. Large plots between the shore and the lagoon produce a surplus above the village needs. There are a few plants of *lautalotalo* with medicinal uses, and various ornamentals—fragrant frangipani trees, bushes of ever-blooming hibiscus, and colorful ti and croton plants—are scattered informally, giving a pleasing effect.

In contrast to the village with this rich and varied foliage, within the pig compounds there can be no cultivation, and the only crops are tree crops, usually limited to coconuts and an occasional breadfruit. In the large compound, however, a few landowners have chosen to enclose small plots with additional walls to protect fields of taro, bananas, or sprouting coconuts. The Matautu section, overrun by foraging pigs, presents a barren aspect compared to the rest of the village with its park-like appearance. Matautu families are dependent on other sections for sugar cane and the products commonly grown near the home. Each cooking hut must be surrounded by a protecting wall, and the banana leaves needed for the ground oven can be grown only within these walls.

Inland from the big compound, and extending for another two miles, are the plantations of the three western sections of the village. (Those of Matautu are on the east side of the Falefa River.) Much of the planting appears as casual and patternless as that in the village: coconuts are found throughout and here and there are small patches of bamboo, kava, manioc,

pineapples, and an occasional kapok tree. In the principal cultivated areas, however, there are many sizable plantings of a single crop. One banana grove covers several acres, and there are smaller plots, totalling a few acres, of cocoa, taro, *ta'amu*, and pandanus. Along the road and adjoining the pig compound is a small grove of oranges.

Faleapuna has been favored in the quality of its farmlands but is less fortunate in the total area allotted to its use. Many of the north coast villages are backed by steep slopes, but the territory inland from Faleapuna consists of the easily cultivated plain of the Falefa River. The lands of adjoining villages, however, confine the area to a narrow strip, one half mile across or less than one half the coastal width of the village. The portion nearest the road is entirely occupied by the pig compound. Cultivation begins farther inland, continuing to the edge of the village of Lalomauga. The portion farthest inland is the most intensively cultivated, with the area known as Punapuna (many springs) containing all of the wet taro patches.

The plantations of Matautu, known as Savaiiatea, are on the east side of the Falefa River extending from the river to the top of the divide. Cultivation covers the limited flat land adjoining the river and extends up the hillside onto quite steep slopes, but does not reach the crest. The land is not as good as the Punapuna lands and poorer yields result, but the area is more accessible to the people of Matautu (Fig. 2).

Within the plantation area the complex land ownership pattern comprises small, irregularly-shaped plots belonging to the *aiga* families with title vested in the *matiai*, still smaller plots owned by individuals, and a few holdings of families of neighboring villages. Property lines are unmarked or crudely marked by notched trees that are of little help to the Land Office in its ambitious attempt to untangle and settle land disputes.

One section of the plantation area known as Sosaiete (society) represents a grant of the village *matiai* to the pastor of the London Missionary Society. It is worked by the children of the Pastor's school, all of the product going to the pastor's family.

Other examples of communal land use are found in the pig compounds and in the village marshlands. The walled area of the pig compound, known as Papu'aa, consists of privately owned plots. With the walled-off exceptions noted above, it is devoted to the run of the pigs. Except for a few small ones kept as pets and allowed to run loose in the village, all of the pigs of Falepoulima, Sapulu, and Salimu families are within the compound. They, too, however, are individually owned and are indentified by ear cuttings—a hole in the left ear, a notch in the right one, etc. After meals they are fed taro and bannana scraps thrown over the wall, each pig knowing his owner's voice and answering his call.

In contrast, the marshlands in the lower part of the village are owned by the community but may be used by individuals. During the drier season some of the marshland is usually planted in *palusami*-type taro of which the young leaves, rather than the tuber, are eaten. In practice, whoever plants and tends the taro can harvest the crop, although the land does not thereby become his permanently. Rows of *ta'amu* are planted to separate the holdings.

The plots of sugar cane in the western end of the village are on private properties, but families in Matautu or others with land unsuited to its production are free to cut leaves without paying. One family has a patch of *u*, the cane of which is used for the rod in roofing thatch, likewise privately owned but shared with all the village.

Growing wild in the village, and free for all, are the *losa*, also producing a cane for roofing thatch rods, and the *sagasaga*, a marsh reed with a seed used for bead necklaces. Finally, regardless of land ownership claims, there are no restrictions on the collection of the useful wood, leaves, or bark of the wild second growth shrubs in the plantation or pig compound area.

The cash crops and some of the food crops are partially prepared in the plantation. Consuming most of the plantation worker's time is the process described as "cutting copra," in which the fallen ripened nuts are hacked in two and the meat scooped out. Husks and shells are discarded, although occasionally some shell is used in the making of charcoal; while the nut meats are carried in baskets to the village for sun drying.

Cocoa is harvested in the pod and also carried in baskets to the village where the beans are shelled, washed, and dried. Taro and *ta'amu* tubers are trimmed and carried in baskets. Bananas, if they are to be used by the family, are cut by the bunch, separated from the stem, and carried to the village. Bananas for sale are cut on boat days only, also separated from the stem, washed in the streams, then carried to the nearest point on the road for crating, usually the store in Lalomauga. Truck crews of Department of Agriculture's "Banana Scheme" deliver the unassembled crate materials, later picking up the packed crates at established points.

Most of the villagers walk the trails to the plantation carrying the produce home on their backs or in baskets balanced on shoulder poles. Some use horses or bicycles, and those with lands far from the village, if also near the road, may use the bus, especially on the return trip with their heavy loads.

Deep in the plantation is a semi-permanent home where one family lives during the week, making copra and drying cocoa beans. For shorter stays a number of families have small *o'o fales*, combination cooking and sleeping quarters on a raised L-shaped platform.

In addition to pigs and chickens, a few families own a cow or a horse which is kept tethered under the coconuts on the higher grounds near the road, or in some instances pastured in neighboring villages. The cows produce but little milk and are kept principally for meat needed when a family member dies and beef must be given to the many visitors. The horses are used to carry produce from the plantation and loads of leaves or firewood from the bush. On boat days they carry bananas to the truck pick-up stations. Before the advent of bus service to Apia they were often ridden to town.

Seafoods, of course, supplement the diet of the villagers, but fishing is much less important in Faleapuna than in many Samoan villages; neither boat sheds nor canoe shelters line its shore. The character of the reef in the immediate vicinity of the village appears to discourage some types of fishing, and mullet do not appear as they do along western Upolu. Only one *tolomai*, or long seine net, is owned by the village; casting nets are likewise seldom used. The women use hand dip nets in shallow water, and the

men spearfish in favorable places, both of these usually representing group rather than individual activities. Use of the large *tolomatu* requires the services of several men and canoes.

The village owns about twenty canoes which are used occasionally for line fishing in the deep water beyond the reef or in the big lagoon where octopus and eel are caught with line and baited hook. At low tide on the reef, women and children gather the edible fauna and flora collectively known as *figota*.

Days are busy in Faleapuna. The village rises with the first light of dawn to take advantage of the cool morning hours. Neighborhood groups, bearing machetes, start for the plantation, separating as they reach the branch paths to their individual plots. Some will spend the day cutting copra or tending crops, some will return after having gathered food for the next few meals. Other groups or individuals go after fish for the first principal meal of the day, which is prepared and eaten before noon.

Before the heat of the day women gather at the pools to wash their clothes and babies, gossiping merrily the while. Others, frequently in groups, weave mats of roofing thatch. The children not in school are busy with the endless tasks of cutting the grass and removing fallen leaves from yards and *malae*. The older men, the *matai* chiefs, if not in council meeting, occupy themselves preparing sennit fiber from coconut, husks and braiding great coils of sennit cord.

During every sunny hour the village becomes one large drying ground as copra, cocoa beans, pandanus leaves for mats, and finished mats are spread out to dry or air. Even the toddlers are kept busy shoeing chickens from the drying copra.

After the morning meal a period of rest is in order, activity resuming only after the warmest hours have passed. When the day's work is done, and before the evening meal, the men, or perhaps the entire family, visit the pools for the daily bath.

School and commuter schedules have altered the traditional routine somewhat, but it remains much as it was. On weekends especially, when all the members of the family are in the village—home from Apia jobs, boarding school, or a stay on the plantation—life is much like that in pre-European days.

Presumably the village was once self-sufficient, but each gain in accessibility from the establishment of the first trading post on the island to the inauguration of daily bus service to Apia has thrust the village deeper into the world of exchange.

Today Faleapuna people are not limited to local produce. The cash crops, copra and cocoa, are sold or exchanged for trade goods in the three village stores. Crated bananas may be sold on the occasion of the visit of the New Zealand boats. About fifteen residents are wage earners in Apia, commuting daily by bus to their jobs as teachers, nurses, or employees of stores, the telephone company, or Public Works.

Additional sources of income for the village accrue from the lower wage rate which prevails compared to that in Apia. One Apia concern frequently sends a truck load of cocoa beans to be sorted by grade. The

task takes some weeks, but the people of Salimu gladly do it for a penny a pound, which is lower than the Apia rate.

Public Works occasionally arranges for the women of the village to make sections of cane roofing thatch needed for schools and other public buildings. The pay, one pound, ten shillings for each one hundred pieces of thatch, goes to the women who sew the sections rather than to the owner of the cane-growing land. Much of the income, like that from the sale of produce or the sorting of cocoa beans, is spent locally in the village stores.

Dependent on truck contact with Apia, the three stores and their adjacent copra sheds are located on the road. So, too, is the barnlike theater whose patrons come by bicycle and on foot from villages three and four miles distant to attend the two evening shows each week. These enterprises occupy western, rather than Samoan style structures, although all are unpretentious, unpainted shacks.

Two of the stores are branches of Apia concerns; the third, "the Chinaman's," is independent and is by far the most popular, thanks to a more varied stock and the liberal extension of credit.

The more conspicuous items on display in "the Chinaman's" are cotton yardage, soap, tobacco, lamps, matches, bread and pies, butter, sugar in one-pound sacks, canned fish and bully beef, and kerosene, which is kept in fifty-gallon drums but sold in small bottles, mostly used beer bottles. A sign on his copra shed reads, "Popo 37: Koko 130-150," indicating that he is currently paying thirty-seven shillings per hundredweight for copra, and for cocoa, 130 to 150 shillings per hundredweight, depending on the grade.<sup>5</sup>

This "commercial core" was not always located here on the bend of the road. A Land Office manuscript map (c. 1928) shows a secondary loop road completely encircling the village along the shore and crossing both lagoon outlet streams, with the leaseholds of Apia merchants, including their stores and copra sheds, located on the shore in Matautu. Population shifts have also taken place in recent years, for a 1924 hydrographic chart<sup>6</sup> indicates clusters of houses in areas no longer occupied.

As new houses are built and old ones abandoned, it is, of course, possible for village populations to shift easily and gradually without any particular pattern developing or significance being attached. The shift of the commercial enterprises, however, is of more significance and can be associated with changes in road alignment. The coast road from Apia dates from German days. A 1913 chart<sup>7</sup> shows a secondary road along the coast from Apia to Falefa just beyond Faleapuna. This was surfaced during the 1920's, but the extension of the road south across Mafa Pass is a product of the post-war era.

<sup>5</sup> The storekeeper declared that he was unable to estimate the quantity of copra and cocoa produced on Faleapuna lands as he also bought much of the product of Lalomauga and Fagaloa as well as some from south coast areas.

<sup>6</sup> U.S. Hydrographic Office Chart No. 0097, *Saluafata and Falefa Harbors*, based on surveys to 1924.

<sup>7</sup> U.S. Hydrographic Office Chart No. 2923, *Upolu Island*, based on surveys to 1913.

After the completion of the cross-island road in the early 1950's, shore location became less important, and location on the main road more desirable. Faleapuna was virtually at the end of the road from Apia before its extension, hence attracted boat traffic from villages to the east and southeast—areas then dependent on water transport but now served by the new road. Accessible Matautu Point was the logical landing and transfer point for produce originating on these coasts.

Faleapuna thus lost its importance as the break-in-bulk point where canoe to truck transfer took place and became instead a highway town. The "business center" then moved from the "harbor" to the main thoroughfare.

Even before the days of the road, boat parties from Aleipata and other villages of the east and southeast coasts used to stop on Matautu Point on their way to Apia or other western landings. Stops were made to rest, to spend the night, to eat a meal, or to await more favorable winds. The village built a *fale* for them which is still maintained although such parties are uncommon now. Before bus service was introduced, the village owned a long racing boat (named Fagamea) which was used for trips to other villages, to Apia, and even to the island of Savaii.

The only remaining boat traffic is that from Fagaloa four miles to the east, a mountain-rimmed bay with small coastal villages still without road connection, and with which Faleapuna has had traditional political and family ties. Passengers and trade produce from Fagaloa now land on Faleapuna's beach at the point nearest the road—copra, cocoa, kava, and bananas to be traded in the village stores, or, along with the plaited mats and baskets, to be carried by bus to Apia for sale in the town markets.

With the lessening of boat traffic and the reduced importance of shore locations, the village loop road was neglected. A few years ago a portion of it was destroyed by storm and has never been replaced. Soon thereafter the remainder fell into disuse and decay. The shore trail to Matautu now crosses the stream on a foot bridge utilizing the old foundations of the road bridge. Another remnant of the old road running steeply down the bluff into the west end of the village can still be used by small trucks, while a portion of another road, formerly the only one to the village of Lalomauga, two miles inland, is still passable into the pig compound and is occasionally used by copra-collecting trucks. These and the main road through the village are the only routes passable to vehicles.

But vehicles are few in Faleapuna. There are no private cars and only eight bicycles. One man owns a bus and makes the Apia run daily, spending the night in the village. His bus is favored by villagers, but not to the exclusion of others. Another resident owns a taxi which he keeps in Apia and uses principally for Faleapuna requirements such as hospital visits.

Bus service is frequent in both directions from Faleapuna as connections are maintained between Apia and the populous southeast coast. Buses stop wherever they are flagged on the road, but the favorite gathering places are the stores.

Footpaths form a network throughout the village. Trails connect each section with the others, with its own spring and pool, and with the nearest point on the road. They cross the stream by simple bridges of two coconut

logs laid together and the pig compound walls by crude stiles of leaning notched logs. The most travelled trails are the one along the shore connecting the *malaes* of the four sections and the one from the *malaes* of Sapulu across the narrow neck of the lagoon to the road where it reaches the Pastor's School, two of the stores, the cinema, and the main bus stop. Its continuation across the road enters the compound where the pigs are fed and becomes the trail to the plantations and a route to the village of Lalo-mauga. The Chinese storekeeper has wisely chosen this frequented spot, although each of the stores is located where a busy trail reaches the road.

Faleapuna has functions that are both rural and urban. Although primarily a farm village (its role historically), after European contact it became a trading center of more than local importance, the extent of which changed with alteration of the transportation pattern.

Thus even the tiniest village may illustrate some of the principals dear to the heart of the settlement geographer, as does, in its miniscule manner, Faleapuna through its layout and functions, its reaction to the impact of western civilization, and its subsequent response to the changing factors of site and situation.

# STATES REORGANIZATION IN INDIA: A CENTRIFUGAL OR CENTRIPETAL FORCE FOR THE FUTURE?

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To many Americans, all disturbances in India are caused by her complex of religions, the abysmally low living standards of her people, or the communists—or some combination of the three. In view of the publicity given these causes of intra-national strife, such conclusions are understandable—and almost inevitable.

But another factor has been much more disruptive in the last decade. It led to creation of a new state in 1953, an extensive reorganization of the states in November 1956, further reorganization in 1960 and may well be the cause of still further realignment of states' boundaries and/or creation of additional states. This factor was language—or rather languages.

Other aspects of India's culture and political history were involved. Religious conflict was associated with disturbances in the Punjab where Sikh demands for a religious state have led to bloodshed more than once. A strongly divergent culture complex underlaid Assamese separatist movements. The people's awakening sense of economic frustration entered every disturbance, and the communist party actively agitated fears, resentments, frustrations, and regional pride. In fact, every aspect of India's human complex entered the drive for reorganization of state's boundaries. But the chief cause of riots between 1951 and the present has stemmed directly from the complex of regional and local languages.

The nation's internal boundaries have been changed drastically in response to this pressure. Will the reorganization have centrifugal or centripetal effects? Either can result since factors favoring both are present. The outcome will depend upon the point of balance achieved. The purposes of this paper are to examine the background of the move and attempt to forecast the likely results.

## BACKGROUND OF INDIA'S LINGUISTIC COMPLEXITY

A brief examination of present linguistic patterns and their evolution is first necessary. India's languages may be divided into four primary families. Two are of major importance and two are relatively minor. The Indo-Aryan languages derived from Sanscrit, and the Dravidian languages derived from Pali dominate. The former are generally associated with northern, the latter with southern, India. Fringing the north and northeast of the country are the minor Sino-Tibetan languages, and scattered through the hilly areas are the equally minor remnant Austric languages, recognized in the constitution as official or "Specialized" languages,<sup>1</sup> the 47 languages

<sup>1</sup> 1951 *Census of India*, "Languages," Paper No. 1, 1954. While Sanscrit is recognized as a "... Language Specialized in the Constitution" (Table 1, pp. 6 & 7), it has no regional significance and little utilitarian importance, being primarily a language of classicists and the arts. The remaining official languages are Hindi, Urdu, Punjabi, Marathi, Bengali, Gujarati, Oriya, Assamese, and Kashmiri in the Indo-Aryan family, plus Dravidian languages Telugu, Tamil, Kannada, and Malayalam.

or dialects spoken by 100,000 or more people, and the 720 languages or dialects with less than 100,000 speakers each. Many of the minor languages are verging on complete extinction with but one to a few dozen persons listing them as their "Mother Tongue" in the census returns. However, each still contributes to India's linguistic complexity with multi-lingualism not merely present but widely mandatory.

The evolutionary details of this complexity are uncertain because of great gaps in knowledge of Paleolithic and Neolithic India and of even much more recent periods. The most recent hypothesis concerning the various prehistoric groups indicates six main races with nine sub-types.<sup>2</sup> The Eolithic Negritos apparently arrived first via overland routes from the west. All but extinct in India today, they contributed very little to the present linguistic picture since, excepting the Andamanese, the survivors speak "... debased dialects of their more civilized neighbours."<sup>3</sup> After the Negritos, several groups of Proto-Australoids speaking a variety of Austric languages and dialects also seem to have come from the west bringing the bases of significant portion of the present patterns. Those were followed by the Mediterranean Dravidian-speaking peoples whose descendants now form a rather solid *bloc* in south India, but who seem to have spread generally over India then. Their languages were apparently quite diverse upon entrance, too, and also became further differentiated with the passage of time. Nordic groups that migrated from their probable hearth area in the Eurasian steppes brought the Aryan languages to India, and western brachycephalics from the Central Asian mountain regions appear to have spread over most of the subcontinent. The Mongoloid peoples remained concentrated in the north and northeast where their Sino-Tibetan languages primarily affect border speech patterns.

Therefore, of the six major prehistoric racial groups that entered the area, five contributed generously to the linguistic patterns as the several languages and dialects of each were variously blended with pre-existing and following tongues to form still further combinations.

Since the Aryan Invasions (c. 2500 to 1000 B.C.) a constant though limited stream of immigrants and a series of invaders have brought numerous languages into the area where many have been lost but others survived more or less modified by contact. Some of the invaders, like Alexander the Great, have received much publicity but contributed little that was enduring. Others, as the Gurjaras, are far less well known but have made lasting contributions. The Gurjaras were one of "... a motley array of unrelated tribes and peoples . . .," who entered India from Central Asia as part of the Hephthalite invasion of the fifth and sixth centuries A.D. After the defeat and retreat of the Hephthalites in 528, the Gurjaras remained and settled permanently in the area now known as Rajasthan, gradually becoming part of the Hindu community—the Rajputs<sup>4</sup>—and contributed significantly to India's linguistic kaleidoscope as well as to other aspects of the nation's culture and history.

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<sup>2</sup> Dr. B. S. Guha, Director of the Anthropological Survey of India, cited by S. K. Chatterji, *The History and Culture of the Indian People*, Vol. 1, pp. 142-169.

<sup>3</sup> See S. K. Chatterji, *op. cit.*, p. 147.

<sup>4</sup> G. Nye Steiger, *A History of the Far East*, Boston.

The Moguls (Moslems) not only achieved considerable fame but also made an especially important contribution to the languages of India, with the development of Urdu which evolved as a *lingua franca* in the camps of the invaders, enabling them to communicate with the Hindu conquered. As such, Urdu combined the Arabic-flavored Persian of the invaders with Hindi and other existing languages and still dominates portions of northern India.

Internally the rise and fall of empires, with attendant movement of armies and resettlement of families, led to further mixing. This resulted in various tongues being spread over considerable portions of India for varying periods as the "language of the rulers." When the empire collapsed many individuals and groups remained to form linguistic enclaves and exclaves. A good case in point is the Andhra people whose original home appears to have been the present Telugu area between the lower Krishna and Godavari Rivers. "With the downfall of the Maurya empire they embarked on a course of territorial aggrandizement, and, . . . overran large tracts of the country formerly ruled over by the Western Satraps (Sakas)."<sup>5</sup> At its peak the empire extended from the core area on the east coast of the peninsula across the Deccan to include sizable portions of the present Bombay State, and northward to the Narmada River, lasting some five centuries until the middle of the third century A.D. This expansion and collapse left numerous groups scattered across the peninsula forming the dominant linguistic groups of villages and tahsils, and even sizeable portions of districts completely isolated from the nearest Telugu-speaking areas.

Finally, Hindustani evolved as a patois synthesizing elements of Urdu and other languages with Hindi to provide a widely used means of communication.

The European languages which have been superimposed over varying areas do not enter the linguistic states question.

So far, two factors have been considered as contributing to India's linguistic complexity. These are the variety of contributors, and time.

Three other factors have affected language dispersion. They are land-forms, vegetation (with its climatic relationships), and traditional transportation media. The high mountain walls of the north with their pendants down the east and west land boundaries of pre-independence India served as barriers, but neither completely nor uniformly.

The arid northwestern mountains have been considerably less isolating than the rainforest-covered northeastern physiography. Once over the mountains of the West and northwest, invaders had the great expanse of the Indus-Gangetic lowland before them and, after gathering strength in the Punjab, moved relatively rapidly across the plains spreading their language patterns over wide areas.

Entrance from the northeast was more difficult because the severely eroded hills and the rainforests of Assam merge with the swampy Ganges-Brahmaputra delta.

Similarly the generally arid east-coastal plain permitted easier move-

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<sup>5</sup> C. Collin Davies, *An Historical Atlas of the Indian Peninsula*, Geoffrey Cumberlege (Oxford University Press, Madras), p. 14.

ment than the narrower, more rugged, often interrupted, and rainforest-covered western coastal plain.

The central plateau, with its lateral hill and low mountain chains and frequent forest areas offered a considerable barrier to movement, particularly toward the east where dissection is more pronounced and higher precipitation produces numerous forests. At the same time it offered many pockets in which limited groups could settle in safety and sufficient isolation to promote marked areal differentiation of languages and dialects.

Therefore the major flow of migration swept down the Indus-Gangetic lowland, and curved around the edges of the Central Plateau to follow the coastal plains. Movement onto the plateau was more akin to a slow infiltration. Relative isolation was the rule rather than the exception here. Even on the open plains the lack of roads, plus the slow rate of movement of pack animals and bullock carts with their limited carrying capacity, and the even slower pace and more limited capacity of *hamalis* (porters) hampered movement.

However, limited means of movement did not completely prevent shifting and Spencer states that, "Despite primitive transport facilities India became surprisingly mobile."<sup>6</sup> Nevertheless that mobility was much less than even today's low per capita travel. More important, as Spencer notes further, it did not produce an amalgamation of peoples though racial mixture occurred more than many high caste Hindus care to admit. Numerous ethnic features became widely adopted, but language did not enjoy equal acceptance with other culture items. Instead it became an increasingly irritating point of differentiation and separation. In spite of physical mobility, intellectual and emotional isolation created such a strong linguistic provincialism that adjacent villages are still often unable to communicate in a common tongue, and at times, interpreters must be obtained for interpreters already employed, even within a single state.<sup>7</sup>

#### DEVELOPMENT OF AGITATION FOR LINGUISTIC STATES

Agitation for linguistic states did not emerge full-blown overnight, nor did it have a single cause. Demands for organization of the Telugu state of Andhra date from the latter part of the nineteenth century. Other groups, particularly the Marathis and Kannadas, have actively agitated for similar states-formation over a like period. The British Raj had taken some steps to satisfy these demands but had never dealt with more than small segments of the problem. At independence some consideration was given to the question when merging princely states and small British states with one another or with large states or provinces. But again efforts were not adequate, though the need was recognized and the boundaries established after partition were considered only temporary by the government of India.

<sup>6</sup> Joseph E. Spencer, *Asia, East by South* (New York, John Wiley and Sons, Inc., 1954), p. 175.

<sup>7</sup> This occurred to the writer on a field trip into the Bastar District of Madhya Pradesh, a tribal area, when an Indian friend who volunteered to act as our interpreter could not converse with local villagers save through an interpreter because our friend spoke only five or six Indo-Aryan languages and English—while the villagers spoke Austric languages.

The bases for these demands are complex but may be summed up in six categories: 1) relict nationalism superseding the nationalism of India; 2) the essential, detailed, disunity of India throughout its history; 3) local and regional isolation; 4) development of several quite dynamic literatures; 5) dissatisfaction with boundaries imposed by the British Raj mixed with feelings of generalized resistance to the conqueror who remained apart, and 6) linguistic-based jealousy, suspicion, and discrimination.

Through India's long historic and far longer pre-historic occupation by man, many indigenous kingdoms and empires have risen and fallen. Others have come into existence following invasions by groups who became more or less assimilated into the Hindu culture pattern. Their posterity remember these past glories very vividly. As descendants of the builders of the Andhra kingdom the Telugus felt entitled to a separate area to be known as theirs, felt an active kinship with Telugus living in other states, and wished to be identified with the great empire of the past. Hence their agitation for Andhra State and dissatisfaction because it did not include nearly half of Hyderabad State and other areas to form Visalandhra, or "Greater Andhra."<sup>8</sup>

Pride of ancestral origin is so strong that members of families which have been in an area for as much as five generations almost invariably identify with the place of family origin. They often speak their ancestral tongue in addition to local languages, follow original dietary patterns and modes of dress, and even transplant architectural styles.<sup>9</sup>

In spite of the movement noted previously, most people did not leave their birthplace. The predominantly rural sedentary subsistence agricultural economy required little extra-regional trade. Besides having strong emotional ties to their land the peasantry generally was economically insecure enough that relatively few would dare venture to a strange area as long as their home village could supply them with basic subsistence. Fewer could succeed in breaking the restrictions of caste and obtain acceptance in a strange area, even from those of the caste they claimed. The combination of landforms, climate, and vegetative barriers, plus extremely poor transportation facilities and a subsistence economy created stagnation and isolation from all but adjacent villages and perhaps the nearest market town. Therefore, local isolation was important. At the same time the prevalent pattern of many separate kingdoms rather than a single political unit was undoubtedly important through history as a cause of regional isolation.

The importance of writing and literature as separating elements between groups is well recognized. India provides a classical illustration of this generalization. Virtually every expression relating to the question of

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<sup>8</sup> Ironically, at least one authority disputes the generally accepted belief that Telugu was the language of the Andhra Kingdom. In "Origin and Growth of Telugu," *The Indian Express, Andhra Supplement*, Madras, October 8, 1953, p.x, Dr. G. R. Sitapati cites evidence that the Andhras spoke a Sanscrit-derived language.

<sup>9</sup> For example, a resident of Nagpur, in central India, stated firmly that he was from Rajputana though he also admitted that his family had not lived in that region for over 150 years and had even disposed of all their holdings there save one small farm. This was retained to continue the family tie to the ancestral village. In essence, this was repeated by many Indians with whom the writer discussed the question of origins, and in other contexts as well.

linguistic states included the issue of regional literatures. Each of the major and some of the minor language groups have developed a dynamic literature over the centuries. This has increased the often bitter resistance to adoption of Hindi as the official language of the nation, particularly in South India, and has also been part of the foundation of many demands for linguistic states.

Dissatisfaction with internal boundaries had existed throughout the British period on grounds that they were “. . . fortuitous. . .” with “no basis in Indian history. . . , and (were) shaped. . . by the military, political or administrative exigencies or conveniences of the moment.”<sup>10</sup>

Furthermore,

“The provincial organization of British India was meant to serve a two-fold purpose: to uphold the direct authority of the supreme power in areas of vital economic and strategic importance and to fill the political vacuum arising from the destruction or collapse of the former principalities. Of these two, the first was obviously the primary objective, and it required the suppression of the traditional regional and dynastic loyalties. This was sought to be achieved by erasing old frontiers and by creating new provinces which ignored natural affinities and common economic interests. The administrative organization of these provinces was intended to secure their subordination to the Central Government, which was the agent and instrument of imperial control exercised from London. This process inevitably led to the formation of units with no natural affinity.”<sup>11</sup>

Growing nationalism brought the first slight consideration of affinities into the division of Bengal in 1905 and its re-division in 1912, with a “policy of balance and counterpoise (beginning) to override purely administrative considerations in making territorial changes, though on such occasions arguments based on administrative needs and other principles were also put forward.”<sup>12</sup> But “. . . the shape of the provinces and the principles underlying their formation, . . . continued. . . to be very far from satisfactory.”<sup>13</sup>

With independence, a large part of this dissatisfaction was transferred to the new national government because the administrative units of British India were basically unchanged and hasty integration of the Indian States (Map 1) led to linguistic and ethnic mis-alignments. Simple inertia of sentiment opposition to “The Government,” seems also to have strengthened the feelings of linguistic states advocates. The last item cannot easily be documented, but is felt in the details of numerous arguments.

Finally, linguistic-based jealousy, suspicion, and discrimination (both real and imagined) provided strong bases for agitation. These actually became more virulent after independence and the beginning of the development plans than they were before. The reason for this was the previous tendency to criticize the (foreign) British administration as discriminating against India as a whole. With independence, the government ceased to be an “outside oppressor,” and represented rule by internal groups.

The Telugus of northern Madras State now felt more keenly than before that the Tamils in control of the state funneled almost all the as-

<sup>10</sup> *Report on Indian Constitutional Reforms, 1918*, para. 39, cited on page 1 of *The Report of the States Reorganization Commission, 1955*.

<sup>11</sup> *Ibid.*, p. 2.

<sup>12</sup> *Ibid.*, p. 3.

<sup>13</sup> *Ibid.*, p. 4

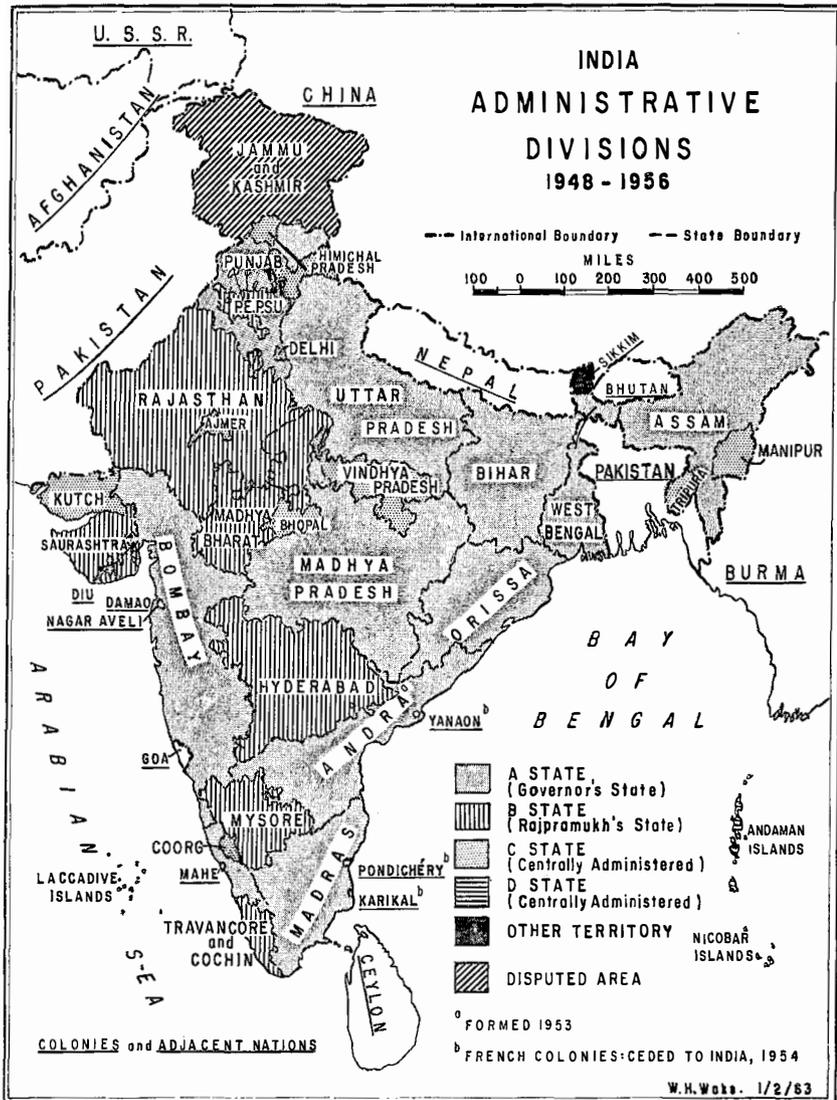


Fig. 1

sistance (and largess), of the central government into Tamil areas. The Tamils denied this to no effect.

Marathis and Gujaratis disagreed similarly in Bombay State while the Marathi-speaking people of Berar complained that the Hindi-speaking leaders of Madhya Pradesh also practiced discrimination, and other linguistic groups showed the same sort of fears and suspicions. The agitation which had increased with the growth of nationalism burst forth with greater vigor at the achievement of independence, and gained a first major culmination with the formation of Andhra on October 1, 1953.

#### PLAN AND PROCESS OF REORGANIZATION

The formation of Andhra did not assuage the desires and claims of other linguistic groups, instead it led to increasingly vigorous agitation. This resulted in formation of a Commission in December 1953 to examine the question of states' reorganization, ". . . objectively and dispassionately . . . so that the welfare of the people of each constituent unit as well as the nation as a whole is promoted."<sup>14</sup>

The Commission decided upon three lines of action: 1) to invite interested individuals and groups to submit documented memoranda expressing their desires; 2) to hold nation-wide interviews, and 3) to study census and other statistical data, including economic and financial information.

On September 30, 1955, the Commission submitted its four-part report. The heart of the report is in Part Two which discusses the factors bearing on reorganization, and Part Three which contains the reorganization proposals.<sup>15</sup>

The items to be considered were broadly inclusive but emphasized language. The Commission's working principles were, first, to preserve and strengthen the unity and security of India; second, to provide linguistic and cultural homogeneity to the states; third, to consider financial, economic, and administrative factors, and fourth, to promote successful working of the national plan.<sup>16</sup>

Two major problems faced the Commission. First, to satisfy as many conflicting demands as possible without Balkanizing India. Second, to provide recommendations that would minimize transitional problems. Both were clearly impossible of achievement, yet must be attempted. The consideration that national development planning must inevitably cut across state lines and linguistic affiliations further complicated the situation.

As finally submitted the recommendations proposed sixteen states and three territories<sup>17</sup> with elimination of the classification of states into categories of unequal legal status.<sup>18</sup> Popular opinion had been very critical of this arrangement, particularly in view of the stated democratic aims of the

<sup>14</sup> *Ibid.*, p. i.

<sup>15</sup> *Ibid.*, p. iv.

<sup>16</sup> *Ibid.*, p. 25.

<sup>17</sup> The Class A States were to be Andhra, Assam, Bihar, Bombay, Hyderabad, Karnataka, Kerala, Madhya Pradesh, Madras, Orissa, Rajasthan, Punjab, Uttar Pradesh, Vidarbha, and West Bengal. Jammu and Kashmir were to have Class B status. The recommended Territories were Delhi, Manipur, and the Andaman and Nicobar Islands.

<sup>18</sup> As defined in the First Schedule of the Constitution, Part A States were

government. Therefore it was felt that the states of the Union should enjoy a uniform status. The institution of Rajpramukh (Maharajas appointed as heads of Class B States) was to be abolished (along with privy-purses). The part B States (save Jammu and Kashmir) were to be placed on a par with the Part A States, and most of the Class C States were to be merged with adjacent states. Part C States not merged and existing Part D territories were to form centrally administered "Territories."

Public reaction to the recommendations varied quite markedly. Turmoil immediately arose in Bombay as Gujaratis demonstrated for a separate state, fearing discrimination by the more numerous Marathis. Each group wanted Bombay City for its capital. The Central Government proposed making it into a separate Territory, which caused both to riot.

Parallel with these disturbances, and emotionally related, the Sikhs demonstrated for a religious state, "Sikhistan," to be formed of the Pepsu area. They have continued to riot and demonstrate periodically into 1962 with widely publicized fasts and inflammatory speeches by their leaders to spur them on.

At the same time the Nagas of Assam proposed to withdraw completely from India and establish an independent nation. Their claims were based on an almost totally different culture pattern from that of the agriculturalist Hindu Indians.<sup>19</sup>

comprised of the larger provinces of British India and were administered by a governor appointed by the president with a chief minister appointed by the governor from the Council of Ministers as his main advisor. These states had a degree of autonomy rather comparable to that of the states in the United States. Part B States were formed of the larger Princely States with adjacent small Princely States amalgamated to them, and of groups of small Princely States. These had considerably less autonomy than Class A States and were administered by a Rajpramukh — the former Maharaja (or Nizam in the case of Hyderabad) or the leading ruler of the group of princes in the case of amalgamated states — as recognized by the President. The Rajpramukh enjoyed powers similar to those of a governor of a Part A State as the executive head of the state. But powers of the state were curtailed. With the exception of Delhi, which in effect has status similar to Washington, D.C., the Part C States consisted of small states in which development was unusually retarded and the population was predominantly tribal. These were administered directly from Delhi by the President through a Chief Commissioner or a Lieutenant-Governor, or by the Government of a neighboring state. However, provisions were made for a High Court and Legislative Council to be established at the discretion of Parliament. These states had very little autonomy though more than the Part D Territories which were administered by the President through a Chief Commissioner or appointed authority with direct regulative as well as administrative authority, and no provisions established for either a High Court or Legislative Council.

<sup>19</sup> These disturbances, the most violent and prolonged of all, actually began some six years ago. They reached a climax in October 1956, and were ended only by a major military effort which brought peace in August, 1957. At this time a convention of some 1500 delegates from all but a few dissident tribes expressed acceptance of union with India but proposed a separate administrative unit. Radmanabhan, P. K., "India's Rebel Head-Hunters Drop Independence Plea," *Los Angeles Times*, September 8, 1957, Part 1, p. A. At the "Naga People's Convention" in July 1960, formation of a separate state was promised and a Draft Constitution presented on February 11, 1961. On August 21, 1962, Prime Minister Nehru introduced two bills to form the State of Nagaland from the present Part B tribal area of Kohima, Mokokchung, and Tuensang Districts in Assam and to amend the Constitution of India to eliminate references to this tribal area. No information has been received concerning passage of the bills.

Communist agitation played a significant part in all these disturbances but amounted primarily to expressions of opportunism as agitators took advantage of a situation to disrupt the process of reorganization and to discredit the Congress Party for political ends. Despite the presence of these non-linguistic causes of disturbances, language was the primary causes of the demonstrations and riots of the period.

After numerous proposals and counter-proposals, peaceful demonstrations and bloody riots, India's Parliament ratified a Reorganization Act embodying most of the Commission's proposals which took effect on November 1, 1956, (Map 2). India then comprised 13 Part A States, one Part B State, and five Part C Territories.<sup>20</sup> Each of the states, save Bombay and the Punjab, had a single dominant language.

Relatively few in number, most of the exceptions to the Commission's proposals were of minor importance. Three, however, were of considerable significance as they radically modified the disposition of Hyderabad, Mysore, Andhra, and Bombay States. The state of Hyderabad was disintegrated, the Telugu-speaking portions being merged with Andhra State which was then renamed Andhra Pradesh. The remainder of the state was joined with the state of Mysore.

Bombay continued temporarily as a bi-lingual state enlarged by amalgamation of the eight Marathi-speaking districts of Madhya Pradesh which the Commission had recommended be formed into the State of Vidarbha. On May 1, 1960, it was divided on linguistic lines to form the States of Maharashtra with Bombay City as its capital (a point of violent contention between the Mahrattas and Gujaratis) and Gujarat with its capital at Ahmedabad (Map 2).<sup>21</sup>

Other, less important changes include separation of the Laccadive, Minicoy, and Amindivi Islands from Madras State to form Part C Territories under direct control of Delhi. Similarly, Himachal Pradesh was set aside from the Punjab, and Tripura was also separated from Assam to become Class C Territories. Only the Jammu and Kashmir retained Class B status.

To facilitate handling of inter-state questions the States and Territories were grouped into five zones.<sup>22</sup> Representation in Parliament continued on the original constitutional bases though numbers were modified.

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<sup>20</sup> The Class A States are Andhra Pradesh, Assam, Bihar, Bombay, Kerala, Madhya Pradesh, Madras, Mysore (it was decided to retain this name rather than use the proposed name of Karnataka for reasons the writer has not been able to ascertain), Orissa, Punjab, Rajasthan, Uttar Pradesh, and West Bengal. Jammu and Kashmir constitute the only Part B States. Delhi, Himachal Pradesh, Manipur, Tripura, and the Laccadive, Minicoy, and Amindivi Islands form the five Part C Territories.

<sup>21</sup> Bombay Reorganization Bill, March 8, 1960. Under the Bill, financial and Parliamentary representations were established for the two states and a separate High Court of Gujarat authorized though its location was not specified.

<sup>22</sup> The Northern Zone consists of The Punjab, Rajasthan, Jammu and Kashmir, Delhi, and Himachal Pradesh; the Central Zone is comprised of Uttar Pradesh and Madhya Pradesh; the Eastern Zone includes Bihar, West Bengal, Orissa, Assam, Manipur, and Tripura; the Western Zone consists of Bombay and Mysore, and the Southern Zone consists of Andhra Pradesh, Madras, and Kerala.

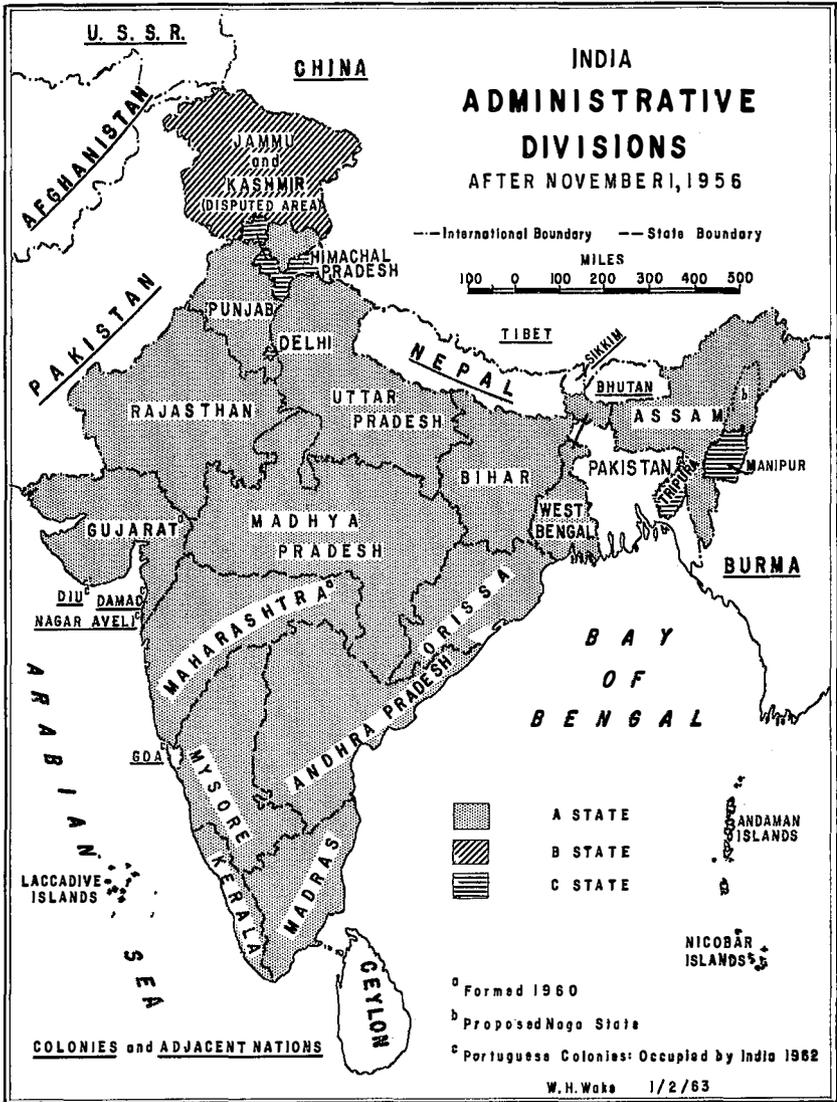


Fig. 2

Six of the states<sup>23</sup> were assigned High Courts. Those of the former Part B States, except Jammu and Kashmir, were abolished along with the High Courts of the absorbed states. Transition period expenditures by the Governors or Rajpramukhs were specifically provided for. Apportionment of states' assets and liabilities was made on the basis of the areas transferred, and assets and liabilities of the union were apportioned on the same basis. Financial corporations established under the State Financial Corporations Act, 1951, were continued in existing states, and payments made by the new states to existing states on the basis of paid-up capital. Inter-state agreements were continued with appropriate adjustments to meet the territorial changes. The Indian Administrative Service and the Indian Police Service continued to provide cadres in each state of the union. Finally, the Act embodied a number of "Legal and Miscellaneous Provisions," such as territorial extent of laws, power to adapt laws, provisions as to certain pending proceedings, and so forth.

#### EVALUATION OF THE REORGANIZATION

It is still too early for complete evaluation of the reorganization. However, certain factors may be considered as bases for a preliminary estimate of the results. Examination of them indicates that both centrifugal and centripetal forces are potentially present.

Economic benefits should accrue to the nation from the reorganization. Operational savings can be derived from the decreased number of states and elimination of privy-purses. Meanwhile much greater long-term benefits to the economy should accrue from rationalization of states' boundaries and elimination of small, previously subsidized units.

The debit side includes the costs of continuing translations while the costs of education will also be directly increased by the teaching of regional languages in addition to Hindi. Continued use of regional languages also poses expensive barriers to business communication. Finally, regardless of linguistic sentiment or lack of rational border-demarkation, economic patterns and relationships were established with regard to existing states' boundaries. Changing these boundaries has required corollary economic realignments; it seems likely, however, that these unfavorable results will have considerably less weight than the long-term economic advantages of the changes.

There is also some question concerning the effects on cities which have lost their state capital function. Opinion is divided rather markedly on this, though it is probable that the growing urbanization and industrialization of India will more than compensate for this loss. Compensatory remedial actions of the central government such as establishment of large branch offices in Nagpur, former capital of Madhya Pradesh have proven to be effective means of countering the inevitable slump that resulted from the exodus of hundreds of state employees with their families and servants.

The emotional aspect of linguistic-boundary placement is of such great and active interest to the people of India that it could over-rule the

<sup>23</sup> Bombay, Madhya Pradesh, Punjab, Kerala, Mysore, and Rajasthan. As noted above, Gujarat and Maharashtra States each were assigned High Courts upon partition of Bombay State in May 1960, making a total of seven High Courts.

objectively more important question of economic viability and cause the effort to fail. Although there seems to have been broad acceptance of the Act, and its subsequent amendment, there were demonstrations and riots against it in several areas. Other less virulent expressions of dissatisfaction were also noted, and many questions were asked concerning the generally unchanged Uttar Pradesh and Bihar borders.

On the whole, violent dissatisfaction seems to have ceased. The changes appear to be enjoying general, though often grudging, acceptance. However, violence may still recur at any time as the result of unfulfilled desires for separation or unification, sparked by economic pressures or other frustrations, or by some sort of incident.<sup>24</sup> Dynamic development programs in such "hot spot" areas can do much to prevent such disturbances.

Politically the reorganization of the nation on the basis of languages might well seem to be a deliberate Balkanization of India with nothing but centrifugal effects to be expected. Establishing seventeen states based upon almost as many different languages will inevitably tend to prolong the life and even stimulate the vitality of these languages. Without entering the controversy over the desirability of this fact it must be recognized that multi-lingualism has proven as disruptive of unity through India's history as elsewhere. Further, it is obviously contrary to the aims of the central government which are to establish Hindi as the single official language.

#### CONCLUSION

Paradoxically the move may well ultimately promote linguistic unification and national unity. The boundaries generally have sound, logical bases. As the reorganization is accepted, the issue of differing languages will cease to be a point of active contention. Furthermore, a people that feels that its government recognizes individual and sub-group aspirations will co-operate more readily with that government.

In this respect, at least, China's aggression against India has beneficial aspects as it has strengthened national consciousness over provincial narrowness and thereby diminished the acute emotionalism associated with linguistic differences. The direct effects will almost certainly be too short-lived to bring true linguistic unification. Their impacts will be of longer duration, however, and will undoubtedly help to promote durable, as well as short-term, national unity.

Therefore, on both logical and emotional bases the reorganization of the states of India will probably produce centripetal results in the long run. This will help to preserve and strengthen the unity of the nation and promote the success of the national plans by providing linguistic and cultural homogeneity to the states with adequate consideration of financial, economic, and administrative factors.

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<sup>24</sup> The late 1957 Dravidian agitation against the Brahmans, led by E. V. Ramaswamy Naicker in Madras State, is an example of such disturbances. Although the campaign has been couched in religious terms it largely centers around racial differences and their linguistic expressions since the Dravidians dominate southern India while the Brahman caste primarily represents the Aryans of the north who developed the caste system. The disturbances continued into 1962 with rioting in Madras on February 17.



# HOW MUCH WEATHER CONTROL?

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Not "Can man control his weather?" but rather "How much can man control his weather?" is the subject of this essay. After a summary of the extent to which man already controls his immediate environment, the possibility and desirability of controls on a much larger scale will be discussed.

## SUCCESSSES

Man already controls his weather to a much greater extent than many of us realize. In three ways he has learned to modify the weather very appreciably: by his clothing, by his structures, and by artificial lighting of various kinds.

Clothing, of course, is a very efficient control of the weather over most of the body. Its primary function is to reduce the rate at which heat is lost by the body. Each of us produces heat, a minimum of 1500 large calories per day. A seated person produces heat at the rate of about 100 large calories per hour. This is slightly more than 100 watts, to use the electrical equivalent.

Were it not for our clothing, this heat might be lost by radiation and by conduction to the air. The very great differences between the climatic conditions outdoors and those within the layers of clothing show that, at least as far as our bodies are concerned, we do exercise a large control over climate.

Likewise, structures of all sorts erected by man modify the climate of the spaces that they enclose. Thanks to heating and its more modern anti-thesis, cooling or air conditioning, we can maintain an atmosphere far different in temperature and in moisture content than that provided by nature.

Both inside and outside our structures we can change markedly the illumination of our surroundings and illumination is also a climatological element. Certainly, the illumination climate in the baseball stadium has been altered drastically.

On a larger scale, particularly in semi-arid regions such as California, irrigation has modified climatic conditions over vast areas. By adding water to otherwise dry soil, the heat capacity has been increased. The resulting crops alter the proportion of solar energy that is absorbed and not reflected upward. In turn, evaporation of the water from the ground and from plants increases the moisture content of the air, thus modifying another climatic aspect.

In each of these examples only a few of the basic climatic elements are involved: temperature, illumination, moisture, air movement or winds, water supply, and the reflectivity of radiation, called technically albedo. These are, after all, the primary climatic elements. When weather control is discussed, modification of one or more of these usually is considered; in most cases, the discussion is restricted to the moisture balance. But other elements have also been subjects of modification attempts.

Windbreaks have been used for centuries to protect habitations and fields. Rows of eucalyptus trees around citrus orchards are common in California. During the 1930's the federal government sponsored shelter belt planting on the Great Plains. Both these plantings are intended to prevent strong winds from reaching either valuable crops or dry erodible soil.

Even such a minor climatic element as lightning has been the subject of serious efforts at modification. Fog dispersal has been shown to be feasible by either of two methods, heating and nucleation.

But weather control in general usually means not the control of the weather over our bodies, or in our houses, or on our streets, or even over our airports, or our agricultural fields. It means the alteration of the basic weather phenomena, the storms that bring our rain and snow and gales. These are manifestations of the gigantic heat exchange system of our atmosphere. It continuously receives heat from the sun in the tropical areas and carries this heat poleward until it can be lost by radiation to space.

When man first tamed the horse and sought to guide a beast outweighing him ten-fold, he found a tender point where pressure of his puny muscles could direct the larger animal. Likewise, if man is to control an atmosphere which daily expends vast amounts of energy, he must find one or more tender spots where the slight pressure that he can bring to bear will be greatly magnified. So far we know of two such points: one is in the process leading to precipitation — rain and snow; the other is in the albedo of the earth's surface.

#### PRECIPITATION

Precipitation is one step in the hydrological cycle. This is the sequence of evaporation of water chiefly from the oceans, its transport through the atmosphere as vapor, the condensation of the vapor into clouds, the gathering of cloud drops into raindrops, the disposition of the rainfall by evaporation and by flow on the surface and beneath it and back to the ocean.

For the past half-century the exact process by which cloud drops become raindrops has been the subject of much speculation, investigation and argumentation. Water vapor is invisible. When the air containing water vapor cools sufficiently some of the vapor condenses to form drops. Dew is one example; so is the water on the outside of glasses filled with a cool liquid.

Cloud droplets do not form out of thin air. They form *on* something: dust particles, plant spores, or other atmospheric impurities, generally less than one micron in diameter. (A micron is one millionth of a meter or about 4/100,000ths of an inch.) The cloud droplets themselves are one to ten or more microns in diameter.

Clouds do not really float in the atmosphere. They settle slowly, but so slowly that in still air they would require more than two months to fall a mile. The larger the water drop, the faster it falls. Only drops half a millimeter or more in diameter fall fast enough to survive evaporation, and the vagaries of the wind, to become rain. A drop one millimeter in diameter falls at the rate of four meters per second, or a mile in about seven minutes — compared to the two months for a ten-micron cloud droplet.

The average drop size in rainfall is about one millimeter or four thousandths of an inch. But one millimeter is a thousand microns and cloud

droplets are only about ten microns in diameter. Hence, the diameter of a raindrop is about a hundred times that of a cloud droplet and its volume a million times. So a million cloud droplets must in some way combine to make one raindrop.

### PROCESSES

Just how this combination occurs is a basic problem in cloud physics. Until about thirty years ago, meteorologists assumed that the cloud drops just kept on bumping together until they formed raindrops. Then the late Irving Langmuir presented mathematical arguments to show that such continuous bumping would take several days rather than several minutes or few hours that are observed. So a different theory, due originally to a German meteorologist, Wegener, was revived, almost simultaneously by a Swede, Bergeron, and another German, Findeisen. It is called the Bergeron-Findeisen, or freezing nucleus, theory.

Because the vapor pressure over ice is slightly less than over water at the same temperature, a mixture of ice crystals and water drops is unstable. The ice crystals grow and the water drops diminish. A few ice crystals introduced into a cloud of water droplets grow very rapidly, and soon attain a size large enough to fall through the atmosphere. Eventually, they may melt and reach the ground as rain.

For more than a decade this was the accepted process by which precipitation forms. Then high-flying airplanes brought back evidence of rain from clouds whose tops were warmer than freezing, and hence could not have any ice crystals. This led to a re-examination of Langmuir's computations and the conclusion that under certain conditions the collision of cloud droplets can be sufficiently rapid to cause rain. Today we consider that precipitation in the colder parts of the world results from the ice crystal process, whereas that in the warmer regions arises through the collision process.

### NUCLEI

A major question in the ice crystal mechanism is the origin of the first few ice crystals. Cloud droplets do not freeze when they are cooled below  $0^{\circ}\text{C}$  or  $32^{\circ}\text{F}$ . In fact, they can remain liquid or super-cooled down to about  $-40^{\circ}$ , at which temperature they suddenly turn to ice. But at temperatures between  $0^{\circ}\text{C}$  and  $-40^{\circ}$  a cloud drop may freeze if it encounters certain tiny particles present in the air. These particles are called freezing nuclei, or crystalization nuclei. As yet, not enough is known about them. Apparently, they are hydrophobic, that is, non-wettable.

The entire field of rain making, which is a major activity in California, is founded on the premise that the atmosphere is somewhat deficient in freezing nuclei. It presumes that suitable artificial nuclei can hasten the transformation of the water droplet cloud into ice crystals, which then will fall as snow and eventually as rain. As yet, no method has been found for determining on what kind of a nucleus a given snowflake or raindrop formed. The larger nuclei can be identified by electron microscopy, but most nuclei are too small for any measurement.

The only known means for detecting freezing nuclei is by the crystals that form on them in a cold box. Quite a few investigations have been conducted of the concentrations of freezing nuclei in the atmosphere. The

results are widely divergent. Some people find that natural nuclei are always present in sufficient numbers to transform water droplet clouds into ice crystals. Others insist that natural concentrations vary widely from day to day and place to place, and in many cases are too slight to provide maximum efficiency.

At any rate, when nuclei, usually crystals of silver iodide, are introduced into clouds, effects frequently are visible. Clouds can be made to grow or to dissipate according to the exact method of nucleus introduction. But whether wide-spread addition of nuclei to clouds causes any significant change in the total amount of precipitation is another matter. Here the analysis is severely complicated by the great natural variability of rainfall.

#### APPLICATIONS

Proponents of cloud seeding claim that it increases precipitation by 10 or 15 or 20%. But skeptics feel that the natural variability is so great that no increase has as yet been demonstrated. Some consider that a quarter-century of continued experience may be required to indicate any increase with the confidence usually required by scientific investigation.

Nevertheless, cloud seeding continues, year after year, because it is considered a good investment by those who pay for it. These people are mostly electric utility managers. Their hydroelectric operations in the Sierra Nevada, the Cascades, the Wasatch, the Rockies, and elsewhere, are so efficient that only a slight increase in stream-flow will bring in more revenue than the cost of cloud seeding.

In many cases an increase of about one percent in streamflow is all that's needed. Such an increase is almost impossible to establish definitely. The Geological Survey claims only five percent accuracy for its stream gauges. No one, least of all the Weather Bureau, would consider an estimate of precipitation over a stream basin, derived from the catches of two or three rain gauges, to be accurate within ten percent. So increases of a few percent, indicated for many cloud-seeding projects, are enough to make the utility manager renew the contract, but are within the errors of measurement as far as the scientist is concerned.

If introduction of artificial freezing nuclei does effectively hasten precipitation, then on a sufficiently grand scale it could cause major changes in the entire circulation of the atmosphere. When water freezes, heat is liberated. If many cubic miles of water drops can be turned into ice at will, a considerable amount of heat can be liberated in the atmosphere, thus changing its thermal balance. Perhaps this freezing nucleus bit can exert sufficient pressure on the tender thermal mouth of the atmospheric horse to guide it for the greater benefit of man. But as yet we have insufficient evidence.

#### ALBEDO

The other possible tender spot in the atmospheric horse is in the disposition that the earth makes of the energy received from the sun. Dark soils may absorb nine-tenths of the sunshine impinging on them and reflect only one-tenth, whereas snow may absorb only a tenth and reflect nine-tenths.

Relatively slight alterations of these surfaces can change the proportions drastically. Dispersal of large amounts of black powder on a snow field can cause it to melt rapidly in the spring or summer sun. Similarly, white powder or other treatment can increase the reflectivity of desert areas.

In principle, such alterations of the natural albedo over areas of many tens of thousands of square miles could change the distribution of heat absorbed by earth. Major changes in the circulation pattern of the atmosphere would result.

#### CONSEQUENCES

Just what would these possible changes do to the weather of San Francisco or London or Singapore? We are in no position to estimate with any degree of confidence. On the whole, meteorology today is still an explanatory science but not yet a predictive one. We can explain yesterday's weather with considerable assurance, but our estimates of tomorrow's have much less confidence.

Three-quarters of a century ago weather forecasters claimed an accuracy of 85%, or six out of seven. Despite all the knowledge acquired in the intervening years and the aids of radio, aircraft, and electronic computers, today's forecasts are still wrong about one time in seven. Some of us feel that this is an inherent characteristic of the atmosphere. We think it has an indeterminate or random component so that no matter how much we know about its physical state today, we can never predict its behavior tomorrow more than six times out of seven.

From this point of view, the consequences of any large scale modification of the precipitation process, or of the albedo, cannot be predicted with full confidence. Whether our present understanding and prediction abilities are sufficient to warrant the undertaking of any attempts at large-scale weather modification is a matter for serious consideration. The probable consequences may be desirable, but we will still have the gnawing fear that a disastrous outcome also is possible.

Then too, no specific change in weather will be considered by everyone as desirable. The resort operator wants sunshine but the farmer may want rain. The skier wants snow but the highway maintenance man does not. Should California's rainfall be increased at the expense of Nevada's? Should Alaska's winters be made warmer if Florida is thereby given more freezes or summer heat?

With aircraft, rockets, and nuclear power man conceivably can *alter* weather over substantial portions of his habitat. But whether he can *control* it in the same way that he controls his rivers and his vegetation is still uncertain.



# A PINCH OF SALT: TRACE-ELEMENT AGRICULTURE IN AUSTRALIA\*<sup>1</sup>

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One hundred seventy-three years after the first English settlers landed at Botany Bay, Australia, the only habitable continent entirely within the southern hemisphere, attained a population of ten million. This was in April, 1959. Why it took Australia, with an area almost equal to that of the coterminous United States, so long to reach this ten-million mark is a many-faceted study and one in which geographers are greatly interested, for here is a welter of physical and cultural threads beautifully entangled. This paper is concerned with the untangling of one of these: why some of Australia's soils were for so long agriculturally<sup>2</sup> useless.

The first decades of white settlement in Australia brought no notice of these shortcomings. There was land in abundance and if one spot proved poor there were many others, since the early settler was a mobile individual. However, by the middle of the 19th century clues were accumulating indicating that some areas were definitely poor agricultural risks. At first these hints related largely to a peculiar malady afflicting sheep grazing on certain areas of calcareous soils in southern Australia; because of its association with coastal areas the disease came to be called "coast disease." While the southeastern portions of the continent were filling up, "coast disease" was little noted and not at all understood, but it became a matter of increasing importance following World War I, when returned servicemen were settled on marginal lands in South Australia and Victoria. These settlers soon began to find their work seriously endangered, first by the "coast disease" in coastal areas, and more alarmingly by crop failures which seemed to be due to soil infertility.

In Australia as a whole there are thousands of square miles of country covered with "light" soils—sandy and gravelly soils of diverse nature and origin running the entire range from skeletal soils forming on sand and rock through podzols and laterites. In southern Australia these "light" soils are associated with a native vegetative cover of scrub forest which may range from heath-like associations to forest. In its typical form, however, this scrub is dominated by eucalyptus of several species, most of which exhibit the "mallee habit," i.e., a number of trunks sprouting from a single, large underground lignotuber. Such a scrub attains a height of 12 to 40 feet and will often be extremely dense; it is somewhat analogous to the larger types of California chaparral. Associated species are acacias, melaleucas, banksias, hakeas, and numerous other shrubby plants. Because these soils and their attendant vegetative associations occurred in those portions of

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\* This paper was originally submitted for last year's publication honoring Dr. John E. Kesseli. Space limitations prevented its inclusion in that issue.

<sup>1</sup> The writer wishes to express his thanks to the various government officials of all the Australian states who kindly supplied data and information which made this paper possible.

<sup>2</sup> In this paper the term "agriculture" will be used broadly to include both farming and pastoral pursuits.

southern Australia where rainfall is sufficient for agriculture and reasonably reliable, it was of the utmost importance to the development of the Commonwealth that the scrub and forest be replaced by crops and pastures. These precipitation characteristics, combined with improving accessibility to urban and overseas markets fostered by an expanding system of railways, induced many settlers to attempt the development. Their experiences were all too often unhappy.

The scrub lands were not easy to clear. As late as 1930 much hand labor was involved, for in heavy scrub or forest the larger trees could only be ring-barked (girdled) and left standing. Lighter scrub could be rolled flat by huge horse-drawn rollers made of sections of discarded steam boilers and burned when dry. Plowing would have been almost impossible because of the roots remaining in the ground had it not been for an ingenious Australian invention, the "*stump jump plow*." This was a multiple (two to four furrow) plow in which each plowshare and mouldboard were hinged from the frames so that when the share struck an obstacle the entire "bottom" swung up and back until the obstruction was passed, whereupon its own weight dropped it back into the soil. In the sandier soils disc plows were often used. A major problem was the regrowth of shoots from the remaining lianotubers, which easily withstand burning. Shoots had to be slashed by hand and some reappeared for several years in spite of the best efforts. Even in 1890 when labor was cheap it cost at least thirty dollars to prepare an acre of scrub land for crops. Broadcasting of seed was a common method, and harvesting was accomplished by another Australian invention, the "*stripper*," a horse-drawn combine in which the power was obtained from a set of gears on a large drive wheel.

Such labor and costs might have been borne if good crop yields could have been obtained, but a whole series of baffling and disastrous phenomena occurred: cereal grains often produced poor straw and failed to fill their seed heads; legumes, such as clovers, would not seed properly, while perennial grasses grew poorly, if at all. Even the use of commercial fertilizers, introduced after 1890, did little to alleviate the situation in these "light" soils, although they were shockingly low in phosphates and nitrogen. These areas, particularly the mallee scrub lands, soon acquired a bad reputation. Occasionally a run of particularly good seasons or higher grain prices would encourage a small foray into these lands, but with few exceptions the discouraged settlers soon withdrew. There the matter rested until the 1930's.

By 1930 the "coast disease" problem was causing major curtailment of pastoral activities in many areas of southern Australia, and the Council for Scientific and Industrial Research<sup>3</sup> was asked to undertake research which might lead to a possible solution. Accordingly, an officer of the Division of Animal Nutrition began field experiments on Kangaroo Island

<sup>3</sup> Later the Commonwealth Scientific and Industrial Research Organization (C.S.I.R.O.). This organization, operated by the Federal government, but enjoying a very high degree of professional autonomy, is specially charged with research into all fields of primary production, although it engages in much other research as well. The premier research body of the Commonwealth, it commands the highest respect in all segments of the population, and a major portion of Australia's recent advancement has been directly attributable to C.S.I.R.O. research.

(South Australia) where the disease was well-known. Eventually the disease was diagnosed as acute anemia, so profound that unless arrested most body functions became involved, even to the extent of deterioration of bone structure. It was discovered that the afflicted animals seemed to recover if removed from the calcareous country where the disease developed and put on laterite country which was equally poor from the standpoint of plant and animal nutrition. Finally, in 1933, the solution was found: the pastures of the calcareous areas were deficient in copper and cobalt, and sheep nearly dead from "coast disease" recovered miraculously when given as little as one milligram of copper and cobalt (soluble) per day, although neither of these elements effected the cure when administered singly.

The next chapter of the story also comes, curiously enough, from Kangaroo Island. Nearly sixty percent of this island carries a suite of laterite and lateritic soils which for a century had defied the best efforts to bring them successfully under crop or pasture. These soils were notoriously low in phosphates and nitrogen, and, although numerous attempts had been made to grow cereal grains on them with the aid of generous applications of superphosphates, all such efforts had failed. The complaints were standard for the mallee country: unhealthy plants and poor yields. In 1936 the C.S.I.R.O. turned its attention to this problem, for similar soils are widespread in southern Australia. The initial aim was to establish permanent pastures in which legumes figured strongly, on the sound principle that if the nitrogen level could be raised, other crops would then thrive. The legume chosen was subterranean clover (*Trifolium subterraneum*), an introduced plant which has proved to be of inestimable value.<sup>4</sup> However, it proved to be impossible to establish a good cover of this legume on the lateritic soils of the island; the seeds did not set properly and no combinations of fertilizers, mulches, and bacterial inoculations alleviated the situation.

By this time a significant body of data had been accumulated in Australia and overseas on the role of various metallic elements in the metabolism of plants and animals.<sup>5</sup> The officer in charge of the Kangaroo Island soil experiments, recalling the recent work on "coast disease" on the island, planted a new series of test plots, some of which received, in conjunction with superphosphates, a very small amount of copper sulphate. The results were most gratifying. Eventually it was determined that much of this formerly useless land could be made into excellent pasture of perennial grasses and legumes if, along with superphosphates, as little as five pounds of copper sulphate per acre were applied.

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<sup>4</sup> The origins of this clover are obscure. It appears to have been noted in pastures in the Mt. Lofty Ranges of South Australia as early as 1890 and was deliberately spread by graziers because of its excellent grazing and propagation characteristics. Although an annual plant, its seeding habit makes it virtually perennial in areas where it becomes established. When its seeds are ripe the seed capsules bend toward the ground and bury themselves in the uppermost layers of soil. A number of varieties have been developed and it has been the most important single pasture plant in the development of the areas of "light" and lateritic soils.

<sup>5</sup> It should be noted that the C.S.I.R.O. was not the only Australian organization engaged in research along these lines. Some of the State Departments of Agriculture, notably that of Western Australia, contributed greatly to the general knowledge of the role of trace elements in agriculture.

This was just prior to the outbreak of World War II, and for the next several years facilities to put the new methods into extensive practice were not available. However, further experiments were carried out on Kangaroo Island and elsewhere. With the end of the war the climate for land development changed abruptly. Thousands of servicemen returned and governments devised plans for bringing men and land together. Now governments and private enterprise were quick to take up the new techniques on a large scale.

Further research in field, test plot, and laboratory disclosed that zinc, molybdenum, manganese, boron, iron, magnesium, and sulphur deficiencies exist in many Australian soils. Once recognized, the correction is usually simple: a small quantity, varying from a few ounces to a few pounds, of a generally cheap salt of the metal are mixed in with the superphosphate which all of these soils require. Soils so treated grow subterranean clover and perennial grasses without trouble, and, when their nitrogen content has been brought up to respectable levels, cereals and other crops may be grown successfully.

Several peculiarities associated with the lack of these minor elements have come to light. First, there is as yet no laboratory method which will indicate whether a soil is deficient in an element or a group of them. The only way this can be definitely determined is by controlled plot experiments on the land itself. Second, while detailed mapping of the distribution of particular deficiencies had not yet been done, enough evidence has accumulated to indicate that they are not consistent in their occurrence over any considerable area. As yet there has been no adequate geological or pedological explanation of why some soils are so grossly deficient in one or more of these minor elements and adjacent soils are not. Third, the role of these elements in plant metabolism is as yet poorly understood; the evidence obtained to date suggests a catalytic role.

After World War II, particularly since 1950, a virtual agricultural revolution has swept southern Australia, based very largely on what has come to be called the "trace element-superphosphate technique" for developing poor soils, especially those of coastal areas or with sandy or gravelly "A" horizon. Although slow to get under way due to restrictions and shortages of manpower and material during the immediate post-war period, the changes which this technique has wrought in the landscape and economy of the Commonwealth have been remarkable.

Because each state has varied somewhat in its methods of reporting these gains, it is not possible to present a composite picture for the entire Commonwealth; however, a state-by-state summary is possible.

*South Australia.* The state in which the new techniques may be fairly said to have begun has profited largely from the discovery. Less than five per cent of the state's area has an annual rainfall of eighteen inches or more, and it has been very important that considerable areas of formerly useless scrub land within the assured rainfall zone could be brought under pasture or crop.

In this state it has been the pastoralist, rather than the farmer, who has been the principal beneficiary of the new techniques, for of the 412,000 tons of trace-element superphosphate sold between 1940 and 1959, only

14,900 tons were used on crops. The bulk of this material, in excess of 212,000 tons, has been used directly in the establishment of new sown pastures,<sup>6</sup> and the amount of land so brought into production during the twenty-year period has been approximately 2,000,000 acres. On Kangaroo Island alone slightly more than 400,000 acres were so seeded. A fuller realization of what this means to the state's economy is conveyed by the fact that government officials estimate that in the districts concerned the number of sheep has increased by about 3,000,000. A conservative estimate of the value of the *annual* production from the additional 3,000,000 sheep would be \$11,150,000 for meat and \$15,610,000 for wool. The benefits are even more remarkable when it is realized that this was entirely unuseable land in 1940 and that eventually a portion of it will be useable for the production of crops as well as sheep.

In South Australia the principal elements which have brought a response in pastures have been copper, zinc, manganese, cobalt, and molybdenum. At least copper is almost always applied as a "standard treatment" for newly cleared land. All of the elements are usually applied as sulphates except molybdenum, which is applied as sodium molybdate. A small amount of cobalt and copper is also applied to pastures in known deficient districts to ensure the provision of these elements for stock. The principal element which has shown a response in cereal crops is manganese.

*Western Australia.* Western Australia is certainly the state in which fullest use has been made of these techniques, largely because a major share of its soils which lie within the zone of reliable rainfall are of the "light" sandy varieties which are notoriously deficient in the minor elements. It is estimated that most of the land in southwestern Western Australia is deficient in one or more of the trace elements. Following World War II new land was brought into production at a rate of more than 750,000 acres per year, and nearly 11,000,000 acres were cleared between 1945 and 1959. Of this total slightly more than half is estimated to have been cleared on established farms, while ninety per cent of the clearing was done in so-called "light" soils. During the same period improved pasture acreages increased by more than 5,400,000 acres. A conservative estimate places the area receiving the minor elements at approximately 9,000,000 acres.

Most of the same elements noted for South Australia have been used in the western state. Cobalt, however, seems to have been little used there, and there are other differences in the use and form of the element applied. In Western Australia, which has its own supplies of copper ore, it has been found that oxidized copper ore is both cheaper and more stable than copper sulphate. Zinc and molybdenum are both applied in oxide form, but manganese sulphate is used as in other states. One other difference is worth noting: Western Australia's major cereal growing areas are based on the "light" soils, and wheat, barley, and oats have all shown a response to applications of copper and zinc. Indeed officers of the State Department of Agriculture assert that it is advisable to apply both copper and zinc to the first crop grown on any land with a sandy or gravelly topsoil. Hence considerable quantities of superphosphate containing trace elements have been ap-

<sup>6</sup> The remainder, approximately 184,500 tons, have been used to supplement the amounts initially applied during the establishment of pastures on new lands.

plied to land growing cereals, a practice which is less common in other states. Western Australia's farmers enjoy one advantage over those of other states: locally manufactured superphosphate contains some zinc and copper as an impurity.

*New South Wales.* It is in New South Wales that the broadest spectrum of trace-element deficiencies has been found to date. Copper, zinc, manganese, molybdenum, magnesium, boron, and sulphur have all been found to be deficient in various districts in the eastern half of the state. It is possible that deficiencies may be present in the western sheep grazing areas, but the broad scale of grazing operations there has not made them apparent. It is also considered impossible to improve pastures on so extensive a scale. Because the eastern portion of New South Wales lies well within the twenty-inch isohyet, where cultivation is possible, considerable attention has been paid to the response of cultivated crops to trace elements. The results indicate there may well be deficiencies which are as yet unrecognized in other parts of the Commonwealth.

One of the most striking responses was obtained by the application of as little as one to two ounces of molybdenum per acre to such legumes as subterranean clover. Yields were, in some cases, increased several times. It appears that in New South Wales this is the most generally deficient element. Another deficiency rarely noted elsewhere in the Commonwealth is sulphur; this lack may be supplied in part by the simple use of superphosphate, but, once an adequate phosphate level is attained, there are cheaper ways of supplying plants with sulphur (e.g. by the use of calcium sulphate). Boron deficiencies have been reported from a number of districts, particularly those in which vegetables are extensively grown and where heavy liming has been carried out to assist in the growth of leguminous pastures. Curiously, a deficiency of copper is less frequently noted in this state than in the southern states generally, and iron deficiency is even rarer, although a response has been obtained with both in certain districts.

Since 1946, when large-scale pasture development and improvement began following World War II, the area of sown (improved) pastures has been increased by approximately 7,500,000 acres. No estimate is available of the portion which received minor element treatment, but from data received from other states and publications of the State Department of Agriculture, it appears that thirty per cent, or approximately 2,250,000 acres, is a very conservative estimate. No estimate is available of the applications to crops, but such applications have been made. It seems to assume that at least 3,000,000 acres in New South Wales have been brought under cultivation or have had their productive abilities materially increased by the use of trace elements.

*Victoria.* The situation in eastern and northeastern Victoria is very similar to that in New South Wales, while the western and southern coastal areas display deficiency patterns more like those of South Australia. The use of trace elements in this, the most intensively developed state in the Commonwealth, has been largely restricted to pastures, although zinc has been widely used in some of the wheat-growing districts. As in South Australia, sandy soils both on the coast and in the western interior respond to the application of copper and cobalt. Molybdenum has proved to be lack-

ing in many areas of the eastern and northeastern portions of the state. Apparently sulphur, iron, magnesium, and boron are generally present in sufficient quantities, although further research may demonstrate their lack in some localities.

Between 1940 and 1959 the acreage of sown (improved) pastures in Victoria has increased by approximately 6,450,000 acres. No accurate data are available to indicate what percentage of this increase has been assisted by the application of minor elements, but because copper and cobalt deficiencies are widespread it is probable that it exceeds the thirty per cent figure adopted for New South Wales. An estimate of forty per cent, or approximately 2,580,000 acres, seems conservative.

*Tasmania.* This, the smallest state in the Commonwealth, has long been aware of trace-element deficiencies, especially in certain islands in Bass Strait, where conditions very similar to those on Kangaroo Island prevail. Copper, cobalt, zinc, and molybdenum appear to be the major and most widespread deficiencies, although responses to boron, iron, and manganese have been reported locally. Thus far systematic research has been largely confined to pasture plants, but, because the state raises important fruit and vegetable crops, investigations are being pressed in these directions as well.

In Tasmania, including its off-shore and straits islands, the total areas under crops and pasture has been increased by approximately 730,000 acres since 1945, when the minor element techniques came into general use. The State Department of Agriculture estimates that at least fifty per cent, or 365,000 acres, has been developed by methods including their use. This does not include the application of trace elements to many thousands of acres of established crops and pastures for which no accurate estimate is available.

*Queensland.* Queensland is the only state which has not used the trace-element techniques extensively. This is not to say that deficiencies do not exist in that state, or that agricultural authorities are unaware of their possible presence. At least 1,650,000 acres of new land have been brought under crop and pasture since 1940, but none of it has been by means of the trace-element techniques so widely used in the south. The reason for this lies in the fact that the lands known to be deficient in some elements are so poor in all respects that it has not been considered economical to bring them under management at all. For the most part these lands lie in the coastal regions of the southeastern part of the state. Other areas, apparently not deficient in these elements, show more promise for development. Nevertheless, agricultural authorities are aware that deficiencies may exist in areas under development.

*The Northern Territory.* This portion of Australia is as yet virtually undeveloped except for extensive cattle grazing based on natural, unimproved pastures. However, it appears likely that at least certain areas of the far north are capable of growing permanent improved pasture and certain crops, such as peanuts, rice, and possibly cotton. Officers of the Division of Land Research and Regional Survey of the C. S. I. R. O., who have been actively engaged in the experimental work done to date, believe that certain light, sandy, and heavily leached soils may hold some potential

for agriculture, and that some of these may prove to be deficient in one or more of the minor elements described above. As yet no data are available and no development using these elements has been attempted.

*Summary.* It is clear that there is widespread deficiency of several of these minor elements in the soils in southern, southeastern, and southwestern Australia. On a statistical basis a conservative estimate indicates that between 1940 and 1959 the following new areas have been brought under crop or pasture by the use of the trace-element-superphosphate technique:

South Australia . . . . .	2,000,000 acres
Western Australia . . . . .	9,000,000 acres
New South Wales . . . . .	3,000,000 acres
Victoria . . . . .	2,580,000 acres
Tasmania . . . . .	365,000 acres
Total	16,945,000 acres

It has been estimated that this amount of new development accounts for at least one third of all the new land in the Commonwealth brought under crop and pasture during the twenty-year period. This new land has considerably bolstered the national economy, has provided homes and property for hundreds of Australian families, and has made possible the Commonwealth's recent increase in population. Certainly this is no mean accomplishment for a few pounds of metallic salts.

## “PORT COSTA,” CALIFORNIA WHEAT CENTER\*

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Less than a century ago, California ranked among the world's leading wheat producers. Enormous harvests from the Central Valley were loaded for export at San Francisco Bay, and sailing ships carried the greater part of this wheat around Cape Horn to Great Britain. At first the grain was handled at San Francisco and lesser Bay ports, but in the 1880's a new warehousing and loading complex arose to become the shipping center for the state's wheat. An interesting combination of geographical and economic factors brought this unique center, "Port Costa," into being on an unlikely site, entirely removed from previous development.<sup>1</sup>

Wheat exporting from California began in earnest in the last 1860's and continued until just after the turn of the century. Its most profitable years were the 1880's, and "Port Costa" grew up in answer to the demands of that decade. Five times between 1872 and 1884 the state was the nation's leading wheat producer. The largest annual wheat export ever made from California was some thirty-nine million bushels dispatched to Europe in the crop year 1881-82. By 1884, the state's wheat lands had reached their maximum extent of more than three million acres. During this era, California's agriculture was concerned almost exclusively with wheat growing.

Today the town of Port Costa is a tiny, half-deserted community on the south shore of Carquinez Strait, midway between Crockett and Martinez. The present cluster of buildings standing near the railroad tracks gives no indication of the bustle of former years. Its name was once well known wherever California wheat was traded—English grain dealers spoke of their ships leaving "Port Costa," not San Francisco. At its greatest extent the wheat shipping center consisted of several vast wharves and warehouses hugging the shore for some four miles, from Crockett to a point just east of Port Costa. In common parlance, "Port Costa" referred to them all. Though narrow, the warehouses measured up to one thousand feet in length, and the largest wharf covered some two-thirds of a mile of shoreline. Their great size provided storage for several hundred thousand tons of grain. Both warehouses and wharves were built out over the water, and the complex assumed a strip pattern due to the location. The hills rise steeply from the water's edge to heights of five hundred to seven hundred feet, and even today there has been little development of this region due to its relief. Indeed, a contemporary wrote that the "Port Costa" warehouses appeared to be clinging to these hillsides, seemingly in constant danger of falling.<sup>2</sup>

\* This paper was originally submitted for last year's publication honoring Dr. John E. Kesseli. Space limitations prevented its inclusion in that issue.

<sup>1</sup> This paper is based on information drawn from the *Pacific Rural Press* for the decade 1880-1890, and miscellaneous pamphlets on Contra Costa County in the Bancroft Library, University of California, Berkeley. Another excellent source is *Wheat, An Illustrated Description of California's Leading Industry*, (San Francisco: 1887), p. 48.

<sup>2</sup> *Wheat . . . op. cit.*, p. 77.

"Port Costa" was successful from the outset, quickly becoming the focal point for the export of California's wheat. During the crop year 1880-81, when only the first warehousing company was complete, it captured almost one-quarter of all wheat loadings at California ports, and three years later the complex was serving over one-half of the wheat carriers leaving San Francisco Bay. By 1887 four-fifths of all the wheat shipped reputedly passed over these wharves.<sup>3</sup> There were two basic reasons for this success and for the choice of the awkward shoreline location. First, from 1880 onward, the state's main arteries of transportation converged at the narrow channel of Carquinez Strait. Second, a number of factors tended to make wheat loading cheaper at "Port Costa" than elsewhere.

Carquinez Strait is the single natural opening connecting California's great interior valley with the sea. This ancient canyon cuts the final barrier of the Coast Range, allowing the waters of the Sacramento and San Joaquin Rivers to reach San Francisco Bay. Prior to the advent of the railroad, these rivers carried most of the state's traffic. Carquinez Strait was so busy that there was even talk of the emergence on its shores of a city rivaling San Francisco. However, with the 1870's and widespread construction, the railroads largely took the place of the rivers. Nevertheless, river traffic continued to move considerable amounts of produce, especially in the Sacramento Valley, and Carquinez Strait assumed renewed importance when main rail lines joined the river traffic along its shores. In 1877-78, a track connecting Oakland and the San Joaquin Valley was built along the south side of the strait. The following year an already existent line to the north was shortened to a new terminus at Benicia, and a rail ferry began operation to a new landing on the south shore, Port Costa. Consequently, virtually all of California's wheat harvest was brought together enroute to market. Not only did rail and river traffic converge at this point, but deep water close to shore allowed the easy approach of ocean-going vessels. Here, where river, rail, and ocean shipping could lie side by side, was an ideal site for a port, with one exception: the relief was an obvious obstacle to building. However, the extensive waterfront available and the saving of many other expenses were to offset the cost and inconvenience engendered by the terrain.

Any reduction in expense is of utmost importance to a low-priced, bulky commodity such as wheat. Consequently, facilities offering maximum savings were attractive to the trade. San Francisco, the state's commercial center and the original wheat exporter, was one of the most expensive ports in the world, due to large fees collected for financing harbor improvements. At other Bay ports there were no such charges, and for this reason Oakland and Vallejo took over considerable wheat loading once they were reached by railroads. However, it became evident that there were still greater potential savings at the "Port Costa" site. Rail freight charges were fifty cents per ton less to Port Costa than to either San Francisco and Oakland, while Vallejo was simply cut off from mainline traffic. Then, too, the proximity of rail and river to deep water shipping possible at "Port

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<sup>3</sup> For activity at "Port Costa" see: *Pacific Rural Press*, July 30, 1881, p. 72; *Report on Internal Commerce of the United States*, House Exec. Docs., 48th Cong., 2nd Sess., No. 7, pt. 3, 1885, p. 440; Contra Costa Board of Trade, *Contra Costa County, California: Its Situation . . . and Productions* (Martinez, 1887), p. 8.

Costa" was advantageous in saving both expense and time in loading. Extra hauling, which had been a particular problem at San Francisco, was unnecessary. At "Port Costa" ships could be loaded simultaneously from barges on one side and railroad cars on the other. The economies possible easily outweighed the cost of the necessary towage of empty vessels from San Francisco to Carquinez.<sup>4</sup> Under these circumstances, as the wheat trade was booming and further business was anticipated, there was incentive for the construction of large loading facilities. Once success touched the first "Port Costa" enterprise, warehouse followed warehouse, forming a center for the wheat trade.

The first warehousing concern was under construction by the middle of 1880, following by a few months the opening of the Benicia-Port Costa railroad ferry. This concern, the Port Costa Warehouse and Dock Company, was located just to the west of the ferry landing and the small valley which provides room for the few buildings of the town. The next year the facilities of the Granger's Business Association were begun still further west, and beyond them the townsite of Crockett was surveyed on a relatively subdued portion of the hills. In 1883 the largest warehousing facility on the Pacific Coast, the Nevada Warehouse and Dock Company, was under construction on the other side of Port Costa. Its buildings, which were capable of holding one hundred thousand tons of wheat, marked the easternmost limit of the port. Other concerns were constructed in quick succession, giving the complex its greatest extent by the early 1890's. The additions were a Crockett branch of Vallejo's long-established Starr Mill, the California Wharf and Warehouse Company, and, finally, Heald's agricultural machinery factory at Crockett, which was converted for wheat storage. Nine major buildings serving the port stretched along the water's edge.

"Port Costa's" life was brief. It shipped wheat for some twenty years, then began to disintegrate, together with the state's grain trade. With the fall of international prices and the rise of vast new producing areas, the wheat trade had virtually disappeared by 1910, and California was turning to a variety of other and more profitable crops. Before the end of the century the Starr Mill had closed. Ultimately, its buildings and Heald's became Crockett's California and Hawaiian Sugar Refining Corporation. In 1910 the Nevada Docks burned. For a number of years produce other than wheat, chiefly barley, passed through the warehouses. Fire claimed another company in the 1920's and yet another at the end of the next decade. Only a portion of the Granger's Business Association has continued to stand, sagging and unused. However, at low tide the outlines of some of the other structures are still visible, marked by hundreds of charred pilings. Although the ferry was abandoned long ago, railroading has kept the now desolate community of Port Costa alive. The "Port Costa" known to the world was created by wheat, and, having no further reason for being, it disappeared in the wake of the trade.

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<sup>4</sup> *Commerce and Industries of the Pacific Coast of North America* (San Francisco: A. L. Bancroft, 1882), p. 204.



# THE STUDY OF THE HISTORY OF SETTLEMENT\*

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One of the fundamental practical tasks of geography is the study of world population. Quite a few works of modern geographers deal with population problems; for instance, in France we have studies by Vidal de la Blache,<sup>1</sup> Damangeon,<sup>2</sup> Sorre,<sup>3</sup> Lucien Febvre.<sup>4</sup> At the seventeenth International Geographical Congress held at Washington, D.C., in 1952, George Cressey, at the time president of the International Geographical Union, took as the topic for his address: "Land for 2.4 Billion Neighbors." For years the International Geographical Union had a commission on Population, later a special commission on a world Population Map. At the eighteenth International Geographical Congress, the special commission presented the new World Population Map on the scale 1:16 million. In addition to geographers, specialists in demography recently have written a large number of studies, the most recent book in French being *Histoire générale de la population mondiale*<sup>5</sup> which came out in 1961.

The population map and other studies show that the earth is very irregularly peopled. On the one hand, some areas are overpopulated; most of the inhabitants are unable to get an adequate amount of food. On the other hand, regions are sparsely inhabited and would be able to support many more people if they were developed. There are, of course, areas where conditions are not favorable to human life: the tropical rain forest, the dry lands, the polar zones and the mountain regions, but among the areas with the same physical conditions, there are great differences in population density. Nowadays, within the temperate climates there are no longer virgin lands which could be occupied by settlers. Therefore, one of the problems of the geographer is to make a survey of land use throughout the world. The population, however, depends on land use only among people who possess only a primary economy, that of depending on agriculture for their living; as soon as a higher level is reached, *i.e.*, as soon as trade or industry are introduced, a given area is able to support a larger population. Switzerland, for instance, would be very overpopulated if the inhabitants had to rely only on agriculture for their living. On the contrary, the country is now importing a large number of foreign laborers to make up for the scarcity of local labor. This is due to the fact that Switzerland is now depending more on industry, trade and finance, than on agriculture.

\* This paper was originally submitted for last year's publication honoring Dr. John E. Kesseli. Space limitations prevented its inclusion in that issue.

<sup>1</sup> F. Vidal de la Blache, "La répartition des hommes sur le globe," in *Principes de géographie humaine*, Paris, 1941, 3rd ed., pp. 19-100.

<sup>2</sup> Albert Demangeon, "La question du surpeuplement," in *Annales de Géographie*, XLVII, March 15, 1938, pp. 113-127.

<sup>3</sup> Max. Sorre, *Les fondements biologiques de la géographie humaine*, Paris, 1943-1952, 3 volumes.

<sup>4</sup> Lucien Febvre, *La terre et l'évolution humaine, introduction géographique à l'histoire*, "L'Évolution de l'humanité," vol. 4, Paris, 1922.

<sup>5</sup> Marcel Reinhard and André Armengaud, *Histoire générale de la population mondiale*, Paris, 1961.

## AIMS OF THE STUDY OF SETTLEMENTS

The study of the geographer has a twofold aim: first he must analyze the distribution of population, not only the statistics and the density of the settlement in each region, but also the forms, the types, the features of the settlements. His study must further explain the reasons for the present distribution by taking into account all factors that have contributed to it; then the geographer must compare the various regions of the earth and show which regions are able to support more population and which are overpopulated. He should, by comparisons between various regions of the world, further suggest means to improve the situation. In some instances migrations may be necessary, but in others a country which at present is overpopulated might feed the same population adequately by introducing modern methods of farming or by creating industries. In the countries of old civilization, the present patterns of settlement, especially the rural settlements, are the result of secular experiments for obtaining the greatest return under the local conditions. New countries will need centuries to reach such a development, and it is possible that they might never reach it, since conditions are changing. This may be seen in studies which geographers have made on regions that have been recently settled.<sup>6</sup>

It is evident that statistics alone cannot give all the needed information. To show that a region is thinly settled does not demonstrate that this region is subject to development. Differences in climate, relief, natural resources may account for very different levels of population density. There are, however, many instances where two regions which are almost identical from the physical point of view present considerable differences in regard to population density, and yet the less populated one would not be able to receive any immigration without a deep or even revolutionary change in the present settlement pattern and economic system. Thus, until the end of last century, the Great Valley of California was nothing but a steppe. At the foot of the mountains a few colonists had settled and had planted fruit trees; in the plain the only possible crops were cereals; wide areas were waste land. Population was sparse. Since the beginning of this century irrigation has been developed, and today the Great Valley is covered with orchards, vineyards, vegetable fields, fat pastures.<sup>7</sup> The number of inhabitants has passed from a few hundred in 1840 to more than one and one-half million in 1950 and cities such as Fresno and Stockton which did not exist one hundred years ago and which have thriven only through the development of the valley have today respectively 133,000 and 86,000 inhabitants. Many industries have been introduced and have developed, and today the Great Valley of California is probably one of the most prosperous regions in the world. It presents much similarity with the Po Valley in Italy.

Not far from it, in the Sierra Nevada, some places resemble valleys and high plateaux in the Jura mountain in Switzerland and in France:

<sup>6</sup> Isaiah Bowman, *The Pioneer Fringe*, New York, 1931; *Pioneer Settlement*, New York, 1932; *Limits of Land Settlement, Preliminary Report on Present Day Possibilities*, Mémoire Américain No. 2, Conférence permanente des Hautes Etudes internationales, Xe Session, Paris, 1937.

<sup>7</sup> Henri Baulig, "La Californie," in *Géographie Universelle*, Vidal de la Blache, XIII, Amérique Septentrionale, II Etats Unis, Paris, 1936.

coniferous forest, pastures, rough climate, much snow in winter, relatively hot summers, scanty natural resources, and restricted possibilities for agriculture. But whereas in the Jura region there are everywhere farms, towns, and even a few cities, the greatest part of the Sierra Nevada is a vacant land. The existence of gold, silver, and other sorts of mines has determined the sites of a few towns; others came up along the lines of the transcontinental railroads; a few isolated houses have been built on the side of the highways which cross the mountains; there are occasional farms, especially in the vicinity of the roads, and that is all. In California the counties which are situated entirely in the Sierra Nevada are very thinly populated: there are 0.5 inhabitants per square mile in Alpine County, 2.3 in Sierra County, 3.5 in Mariposa County, 4.1 in Plumas County, 6.3 in Tuolumne County.<sup>8</sup> Nobody thinks, however, about settling those wide regions (Alpine County covers an area of 723 square miles, Sierra County 958, Mariposa County 1455, Tuolumne County 2275, and Plumas County 2570<sup>9</sup>), and with the present situation settlements which might be started would probably sooner or later be failures since, while it is easy to get colonists to settle in regions with pleasant climates, it is much less simple to colonize less favoured regions.

Everywhere that regions of little attractiveness are populated, their settlement has been very slow and the process has lasted for centuries. It is not merely for pleasure that men have gone to live in the mountains; it is because they found there some advantages. The valleys of the Alps were settled very early because they offered shelters easy to defend against barbarians who might try to attack them. The high valleys and plateaux of the Jura, which were covered with thick forests until the Middle Ages, attracted monks who were looking for solitude; they founded hermitages, convents, abbeys, and, to get food, they cleared the surroundings and cultivated the soil. In order to settle the high regions of the Jura, the lords granted special privileges to men who would come and settle there: special freedoms, exemption from taxes and military service. These were solemnly confirmed in charters. For instance, in 1384, the Bishop of Basel, Imer de Ramstein, granted to the inhabitants of the high plateau which henceforth was called "Franches Montagnes" (Free Mountains) exemption from any tax.<sup>10</sup>

Today the inhabitants of the mountains and the inhabitants of the countryside do not enjoy any special privilege; they must pay the same taxes and are subject to the same military obligations as the city dwellers. The latter have an easier life, earn their living with less effort, enjoy more entertainment, and find it easier to give an education to their children. It is therefore no wonder that there is a constant migration from the mountains to the lowlands and from the rural areas to the cities.

It is the study of settlement in regions of old civilization, the analysis of the facts that led to the full development of the areas, that will provide the geographer with the means to advise what should be done to help in

<sup>8</sup> Figures taken from *U. S. Census of Population, 1960*. Also *World Almanac, 1962*, New York, p. 281

<sup>9</sup> *Ibid.*

<sup>10</sup> P. O. Bessire, *Histoire du Jura bernois et de l'ancien évêché de Bâle*, Porrentruy, 1935.

eliminating overpopulation either by favoring emigration or by improving the living conditions of the residents, to discover regions which would be able to support a large number of inhabitants, and to help settling them.

#### SOURCES AND METHODS OF STUDY

There are many types of settlements which can be classified according to the occupations of their inhabitants: hunting, fishing, agriculture, trade, industry, mining, administration, etc. At present most settlements have diversified functions, but since agriculture is at the base of all civilizations the study of rural settlements is the most significant and the most useful. It is now easy to make a distinction between rural and urban settlements, but it is quite difficult to make it for the past. In countries of old civilization, however, except for a few cities the settlements were agricultural; therefore, by studying the history of rural settlement in ancient times we study at the same time the history of settlements as a whole.

Four sciences contribute to the study of the history of settlement of a region in a country of old civilization such as Switzerland: history, archaeology, toponomastics, and geography. There are other sciences, more or less connected with one or the other of the four mentioned ones, which may also give some information or confirm hypotheses; they include, among others, anthropology, ethnology, philology, ethnography, jurisprudence, and soil science. Let us see what each of the four main sciences may contribute.

##### *a. History*

History, taken in its restricted sense, *i. e.*, the branch of knowledge dealing with events that have taken place in the world's existence as described in written papers, is generally the most accredited source and even it gives only scanty indications. First the historical times start rather late in Switzerland. The earliest mention of Geneva, for instance, is found in Caesar's "De Bello Gallico," Caesar having come to that city in 58 B. C. At that time it was already a fairly important locality, and it had not reached that development in a few years only.

Furthermore the historians are chiefly interested in striking events, conquests, battles, or notable men, and much less in civilization; in regard to religion, they will deal with the lives of saints rather than with the establishment of churches and parishes. Only a few of the historians of antiquity are of any use for the history of settlement: solely Caesar Tacitus, Orosius, Dion Cassius, Ammianus Marcellinus give information about settlements in Gaul. For the early Middle Ages, Gregory of Tours and Fredegarius offer some useful material. From the XIth century onward, sources are more numerous. The archives contain chartularies, registers of benefices, and chronicles which include names of many settlements; but the origin of the places is not indicated and often can only be arrived at by deduction. For many settlements the first written mentions are only found centuries after the foundation. This situation remains the same in modern times; many place names were first written down officially when detailed official surveys were published. Historical studies and documents should not be neglected, but they are not sufficient to supply all information for the history of settlement.

### *b. Archaeology*

This is a very useful source of information for the early periods of settlement; prehistorical and the beginnings of the historical times. Archaeologists are, like geographers, men who make field studies, and often geographical factors have led them to important discoveries. The work of the archaeologist has only recently become systematic; the archaeological maps give useful indications, but they show scattered finds, and the settlements that archaeologists have surveyed are very few in comparison with the settlements that must have existed. Nevertheless archaeology may add accurate data.

### *c. Toponomastics*

This is a rather recent science, though the explanation of the meaning of place names is very old. Many examples may be found in the Bible. In the Genesis, for instance, we read: "And the herdsmen of Gerar did strive with Isaac's herdsmen, saying The water *is* ours: and he called the name of the well Esek; because they strove with him. . . . And he removed from thence, and digged another well; and for that they strove not: and he called the name of it Rehoboth; and he said, For now the LORD hath made room for us, and we shall be fruitful in the land."<sup>11</sup> And in the New Testament: "And they bring him unto the place Golgotha, which is, being interpreted, The place of a skull."<sup>12</sup> Virgil tells us that Aeneas founded a city in the Latium and named it Lavinium after his wife's name.

Throughout the Middle Ages and until now, many writers have looked for the significance of place names, and sometimes they altered the spelling of some names that they did not understand in order to be able to explain their meaning. Legends have been created to support theories, and when cities or states have chosen coats of arms they have often based them on doubtful hypotheses of origin. It is only since the middle of last century that toponomastics has become a science and has started to work methodically and systematically. It has already developed some general principles. In 1938, the first international congress of toponomastics was held at Paris. It focused the eye of the world on that science. Toponomastics is now a great help in the study of the history of settlement.

### *d. Geography*

Geographers have studied the forms of the rural settlements and noticed two different groups: the isolated farmsteads and the clusters or villages. In France, at the beginning of the century, when French geography started to flourish with such men as Vidal de la Blache, Demangeon, Arbos, Sorre, Musset, and Blanchard, studies were made in the different fields of the science. Demangeon undertook the study of rural settlement forms and defined the principles of his study: a classification based neither on the material used in the building, nor on the external aspect, but on the function, the relation between men, animals, and things, and he gave a first synthesis for France. In 1925 he presented at the International Geographical Congress at Cairo a paper on the influence of agrarian forms on the

<sup>11</sup> Genesis, 26:20, 22.

<sup>12</sup> Mark, 15:22.

types of settlement in Western Europe.<sup>13</sup> A Commission on Rural Settlement was then constituted; it held meetings at the next congresses. In 1927 Demangeon himself published his geography of rural settlement.<sup>14</sup> In local studies geographers generally deal with the history of settlement based on geographical factors, but geography by itself is not able to supply all data.

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As already stated other sciences should be able to give useful data for the history of settlement; anthropology, philology, and jurisprudence, for instance, should, it seems, be able to learn the origin of the peoples who settled first and cleared the land, but so far they have done very little work on historical problems. Soil science has furnished some information on the age of land clearing in some areas, but this can be done only for isolated spots as the process is rather complicated. As a whole, those sciences may only be used to support and to confirm hypotheses formulated by the other disciplines.

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As we see, no science is able by itself to establish the history of settlement but all of them can give useful data. It is the task of the geographer to utilize those data, to combine them, to confirm them by taking into account geographical factors such as relief, hydrography, climate, vegetation.

Taking a region, the geographer will gather all data that he may find. Then, for each period, he will put them down on a map. Let us take an example: the period of Roman occupation in Switzerland. History tells us that in 58 B. C. the Helvetic people, after having burnt their towns, villages, and farms, left their country in order to settle in Gaul, but, beaten by Caesars's army, they had to return and rebuild their homes; they were then under subjection by the Romans. Only a few cities are mentioned. Toponomastics shows some place names of Roman origin or of earlier origin. It informs us further about the naming process of the villas in Helvetia; as in Gaul, the name of the founder or the family of the founder received the suffix -acum; thus Martigny comes from Martinius + acum, *i. e.*, Martin's villa. Most names ending in y have such an origin. Archaeology comes in to support the thesis; if any object or ruin of Roman origin has been found on the spot, a place with a name ending in y is confirmed as being of Roman origin. There will remain a number of places, the names of which appear to be of Roman origin, but where no archaeological finds have been made. The geographer studies the local environmental conditions and is able to decide whether or not the places are of Roman origin. He then may be able to draw a map showing approximately what was the extent of the land settled in Roman times.

### CONCLUSION

The study of the history of settlement has not only a value for History as a whole, but it may explain the present distribution of popula-

<sup>13</sup> Albert Demangeon, "De l'influence des régimes agraires sur les modes d'habitat dans l'Europe occidentale," in *Compte rendu du Congrès international de Géographie du Caire*, Le Caire, 1925.

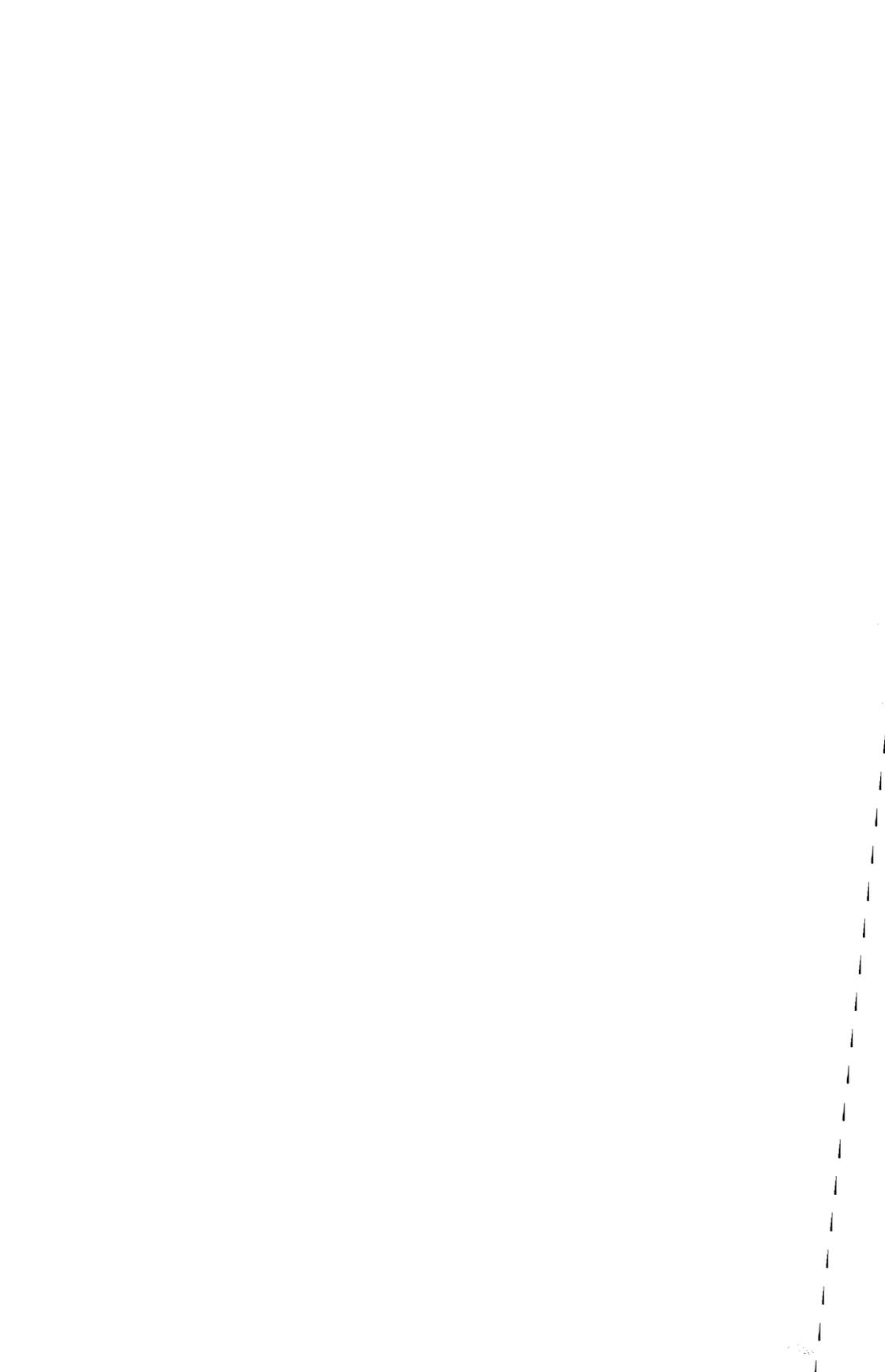
<sup>14</sup> Albert Demangeon, "La géographie de l'habitat rural," in *Annales de Géographie*, XXXVI, 1827, pp. 1-23.

tion on earth. It is therefore of great interest for specialists concerned with colonization problems.

The history of settlement in countries of old civilization, such as Switzerland, has to be made by geographers; they will make the synthesis of the data furnished by history, archaeology and toponomastics. The first step is the local studies; when enough local studies will have been made, it will be possible to produce a complete history of settlement in a given country.<sup>15</sup>

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<sup>15</sup> (Editor's Note) M. Perret has published two papers utilizing the method he outlines: "Le peuplement du Pays d'Erguel." *Regio Basiliensis*, Vol. I, No. 2 (1960), pp. 153-161, and "Localités suisses tirant leur origine de domaines gallo-romains," *Geographica Helvetica*, Vol. 15 (1960), pp. 248-251.



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