A Proposed Santa Fe Trail National Area[1]

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In terms of time, we are in the Mid-Twentieth Century — an era of immense technological advance and sophistication. A generous resource base coupled with marvelous ingenuity has provided a great array of increasingly automatic artifacts designed to relieve man more and more from the drudgery of making a living. Despite all this progress, it is by no means certain that there is at hand the means to counter effectively distress due to environmental vicissitudes.

The fortunes of the residents of the Southern Great Plains since settle-

ment are of particular interest in this connection. At least twice since settlement of the region, which began in the 1880's, distress reached such disastrous proportions that great emigrations took place. In each instance, the exodus was occasioned by a particularly severe drouth — one in the 1890's, the other in the 1930's (Thornthwaite, 1941). Aside from extra-regional economic conditions, which sometimes are distressing, explanations in economic terms alone do not go deep enough (Huxley, 1949). Misfortune, as well as land-use problems (Muehlbeier, 1958), within this region appear associated largely with climatic vagaries.

A brief review will indicate some far-reaching ramifications and the complexity of this great problem. Average annual rainfall, for example, ranges from 15 inches in the western portion to 25 inches in the eastern part of the region, but such a statistic does not mean much in terms of crop production effectiveness because the rate of evaporation is excessive — up to 60 or more inches a year (Visher, 1954). And besides, a third of the average annual rainfall may come in one day (Thornthwaite, 1941).

Drouth is frequent and severe over extensive areas of the Great Plains. An average frequency of as many as 3 drouth years out of a 10-year period is reached (Campbell, 1936). Hail, frost, and hot, desiccating winds, in addition, are weather hazards particularly severe in the Great Plains (Thornthwaite, 1941). Added to these are blizzards and dust storms. The most recent serious blizzard was that of March 1957 (Dye, 1957), which resulted in much damage and loss. Dust storms, another feature of the region, also are frequent and sometimes severe. On account of them, the region has become known as "The Dust Bowl!" In earlier years, it was recognized as part of "The Great American Desert" — a widely used geographic term about a century ago (Webb, 1936). Included within this vast area is a lesser one between the Arkansas and the Cimarron Rivers in western Kansas formerly known as the "Dry Desert, or Jornada." This was a perilous crossing on the Old Santa Fe Trail.

The level-to-gently-rolling, treeless tract, known as the Southern Great Plains, includes about 130 million acres of prairie land south of the Wyoming-Colorado and the Nebraska-Kansas state lines, and from the eastern slope of the Rocky Mountains to about the 98th meridian in Kansas and Oklahoma. Its boundary swings southwestward in Texas to the southern border of New Mexico to include the Texas Panhandle and adjacent areas of Texas and eastern New Mexico. In all, this region represents about one third of the total area of the five states, Colorado, Kansas, New Mexico, Oklahoma and Texas, included within it (Savage and Costello, 1948). So bounded, this region does not extend as far southward as Fenneman's (1931) Great Plains Province does, the southern part of which extends some three degrees of latitude further.

"The soils range in texture from dune sand to heavy clay" (Savage and Costello, 1948). Some of these lands are adapted to cultivation, and others to use as rangelands. The hardlands are subject to severe water erosion — the sandy lands to intense erosion by wind.

Five of the major streams rise in the Rocky Mountains. Other important streams rise on the High Plains themselves. Much of the time these streams carry little water, or their beds are entirely dry. Upon occasion, however, any one of them can become a raging torrent of silt-laden water. During one of these periods of torrential flow, in 1914, the channel of the Cimarron River became drastically altered in the Panhandle region (Hibbard and Rinker 1942).

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The region is characterized further as a grassland or prairie, which appears to have developed in late Tertiary times (Elias, 1942, MacGintie, 1953). The development of this vegetation type is associated with the forming of the Rocky Mountains system to the westward during this period, an effect of which was to give the Great Plains its "present degree of aridity" (Schuchert and Dunbar, 1941).

A significant feature of the later Tertiary among the mammals was the appearance of hypsodonty in the molars of a large number of several orders. This feature is associated with the development of prairie and it became characteristic of many of the horses, camels, ruminants and rodents (Scott, 1937). Representatives of the last two groups still persist in the Great Plains region. During more mesic epochs, like the Lower Pliocene of Beaver County, Oklahoma, for example, important stands of a number of species of deciduous trees developed adjacent to the stream courses. "There was sufficient rainfall to support a floodplain forest like that today in central to eastern Oklahoma, 180 or more miles to the east, where modern equivalents of all the arboreal species are now living," (Chaney and Elias, 1938).

From the Upper Pliocene of Meade County, Kansas, an area adjacent to the Cimarron River, Hibbard (1941) on the basis of fossil mammals has been able to indicate the presence of the following ancient communities: upland grass, semi-aquatic, meadow-marsh, forest and valley slope. The meadow flats and timbered areas he recognized as occurring along portions of a stream valley. The climate presumably was more equable than at present — neither so cold in winter nor so hot in summer, and somewhat more humid. On the basis of fossil birds from the same beds, Wetmore (1944) corroborated the inferences of Hibbard. Four of the birds, the bufflehead, turkey, Virginia rail and mourning dove, are still present in the region.

Through the Pleistocene fossils of southwestern Kansas, Hibbard (1949) was able to indicate an alternation of cool and warm periods, culminating in a cool and humid climate for the Jones Fauna of the Late Pleistocene. The present Great Plains aspect of this fauna is indicated, among the fossil birds, by the upland plover, lark bunting and longspur (Downs, 1954); and among the mammals by the badger, Richardson ground squirrel, prairie dog, pocket gopher, grasshopper mouse and prairie vole (Hibbard, 1949).

From the Great Plains region of Nebraska (Barbour and Schultz, 1937) to southwestern Kansas (Hibbard, 1949) and to southwestern Oklahoma (Meade, 1953), and from Late Pliocene to Late Pleistocene, typical plains animals like the horse, camel, pronghorn, bison and mammoth were present and apparently undergoing speciation. Of these, only the pronghorn and the bison survived.

Through this great span of time, paleoecological evidence indicates the continuous existence of a prairie habitat on the Southern Great Plains. The variations in climate that seem to have occurred do not seem to explain the ultimate extinction of forms which had persisted for so long. Rather they were such as alternately permitted the spread of bottomland forest out into the plains and their recession back down the valleys again.

A similar though lesser sort of vegetational oscillation in later years has been noted among prairie grasses, where before the drouth of the 1930's, buffalo wallows supported stands of mesic grasses. During the drouth, these gave way, in most instances, to buffalo grass, which in turn yielded to the mesic grasses with the return of increased rainfall (Weaver and Albertson, 1956). Similar oscillations for a different situation have been reported by Albertson, Tomanek and Riegel (1957), among others.

Associated with each of the interglacial intervals of the Pleistocene was the deposit of loess beds in the moist prairie region northeastward from the Southern Great Plains. Of these, the Peorian deposit is reported (MacClintock, 1937) to be at once the thickest and most extensive, reaching from western Kansas and Nebraska, across Iowa, Missouri and Illinois and down the Mississippi Valley to the Gulf. An earlier deposit, the Sangamon, is a characteristic reddish-brown in color. It has been suggested that this material had its origin in the Red Beds to the Southwest. The dust storms experienced in the 1930's and again in the first part of the 1950's may be viewed as the modern counterpart of conditions contributing to these ancient loess deposits.

Early man witnessed some of this Southern Great Plains "paleohistory." The oldest dated archeological site appears to be the Lewisville, on the Trinity River in Denton County, Texas, (Anon., 1956). This was aged at more than 37,000 years, and there were associated with its ancient hearths, a Clovis projectile point, and the bones of bison, deer, wolf, prairie dog, rabbit, birds, freshwater clam and snail shells and charred hackberry seeds. About this site there were also bones of elephant, camel, horse, antelope, coyote, giant sloth and many smaller mammals (Brannon, *et al.* 1957). Sellars (1940 and 1947) and Macgowan (1933) provide useful summaries of the finds concerning early man in America, all of which antedate the Basketmaker Culture. These finds are important, among other reasons, for the information they provide concerning the occurrence of plants and animals. These in turn assist in the reconstruction of ancient environments and in the succession of these. The more than 30 finds reported for the Southern Great Plains are rather generally distributed in the region.

The historical record from early man to the pre-Columbian Indian is not a continuous one. No smooth transition has been traced from one cultural period to another. It has been pointed out, moreover, that extinct forms of the bison have not yet been found in any of the known "Neo-Indian" sites; and with one possible exception, the modern bison has not been found in any "Paleo-Indian" sites (Forbis, 1956). According to the same author, early man seems to be separated from later man on the Great Plains by a drouth period of some 3000 years, beginning about 6500 to 7000 years ago. He did not give his evidence for this conclusion; however, if such a drouth did occur, it may explain the extinction of the camel and the horse just before the opening of the Recent epoch.

While there seems to be, in recent history, no indication of a comparable age-long drouth, Schulman (1956) in connection with his dendroclimatologic studies, observed that the 13th century was extraordinarily dry, with a pronounced and extensive drouth from 1573-1593. Douglass (1935), who also recognized this extended drouth, had already suggested it as a possible reason for the termination of the Pueblo III culture, to which he referred as the golden age of southwestern pre-history. Douglass (1935) also noted that the great communal houses in Chaco Canyon, New Mexico used great quantities of pine timber, suggesting the former presence of a forest nearby.

It seems plain, from the historical record of the Southern Great Plains, that vegetation, wildlife, and man, too, must have experienced extreme distress from time to time, due apparently to unfavorable climatic conditions. The regional distress still periodically experienced is nothing new. This appears true also of the region's climatic vagaries, except that for the modern situation, we are by comparison, dealing with the phenomena on a short-term basis. Schulman (1956) suggested that the present pattern, beginning about 1870, is beginning to look like the drouth pattern that developed in the 13th century. Weatherwise the Southern Great

Plains are truly dynamic, and this quality is reflected beyond reasonable question in the ecology of the region.

It is evident from the work of Carpenter (1940), Clements and Shelford (1939), Dice (1943), Malin (1956) and Weaver and Albertson (1956) and the bibliographies they provide, that the Southern Great Plains has been the subject of considerable ecologic study. No attempt will be made here to review these studies; however, one conclusion which should not be overlooked is the fact that study of the region has been dominated largely by a single school of thought. A scientifically well-rounded understanding of the region's ecology is lacking to the extent that this criticism is true. The philosophies of the so-called Montpelier School, those of the Baltic region, and of certain individuals, like H. A. Gleason, seem to have made no noticeable impression upon those who have studied this region. The British school might also be mentioned, but among the European schools it parallels closely the dominating American school.

The dominating interest has been mostly concerned with the concepts of succession and climax and with the structuring of a complex system of community classification. One product has been a profuse hierarchical taxonomy, leading it seems, more to confusion than clarification. The validity of the idea of climatic climax has been ably questioned most recently by Whittaker (1953), and by Malin (1956). The former author offers his own concept of climax. He calls it the "climax pattern" concept with climax vegetation as a pattern of populations corresponding to the pattern of environmental gradients. Corollary to this concept is the recognition that all climaxes are physiographic, edaphic, and biotic as well as climatic, and that distinctions between climax and succession at any level are necessarily relative. This concept seems free of the static quality of the Clementsian climatic concept. While Clements considered his concept to be dynamic, in application it seems more static than dynamic. A dynamic concept appears essential to the study of spreading or receding vegetation, a phenomenon associated with its entire known history of development, and a phenomenon observed today with time and space oscillations associated with fluctuations between wet and dry periods of climate years. This prompts a second criticism of the work of the dominating school: it is not pursued in the context of history or tied to the span of time extending from the present back through the period of exploration into ancient time, a shortcoming indicated by Malin (1956).

At any rate, much groundwork has been done in the identification and description of flora, fauna and of ecologic associations; and in refinement of study techniques (Hanson, 1950). Behavior of biotic associations in relation to some climatic conditions and to overgrazing also have been studied (Weaver and Albertson, 1956; and Albertson, Tomanek and Riegel, 1957).

Hanson (1952), further, has stressed the need for *process* research such as that of Hanson and Vorhies (1938) concerned with biotic community processes like invasion, competition, association and succession. Also of importance are: ecologic life histories of important plants and animals, interrelations of rodents to vegetation, soil, grazing, predation and climatic conditions; determination of agro-climatic analogues; and correlation of multiple use of grasslands and prevention of waste (Hanson, 1952). To these may be added the question: "What is the true ecologic role or status of mesquite, sandsage and shinnery oak?" Large tracts of these vegetation types are being subjected to herbicidal treatment from the air. It is exceedingly urgent that representative samples of these be saved from destruction. The ecologic relations and significance of cactus and yucca likewise are imperfectly known.

The profiles of weathering of the regional soils need greatly to be

determined upon an expanded basis, since "they reflect the climatic, topographic, and vegetative" environments in which the soil deposits have existed (Leighton, 1937). Fossil soils need to be studied for their implications as to vegetation and climate (Thorp, 1949). The fauna of the different soils needs urgently to be studied. Jacot (1940) already has pointed out that land management must consider the soil fauna, surface animals and vegetation in their entirety.

There are many wildlife problems in addition to the rodent and soil fauna problems mentioned above. For example, the lesser prairie chicken is indigenous to the "Dust Bowl Region." In definitive terms, what is its habitat? And what do we know about the welfare of this population? Both the scaled quail and the pheasant reach range peripheries in the Southern Great Plains region. What limits their further spread beyond their present peripheries? What are the dynamics of a range peripheral situation? Was there an interdependence between the bison and the pronghorn? If so, what was its character? Insect ecology presents an enormous problem. Before settlement, for example, as many as 25 grasshoppers were counted upon what was judged to be an "Average square foot of ground," leading to an estimate of more than a million to the acre (Ludlow, 1875). In the wake of a long drouth, millions of acres in the Great Plains were seriously infested with this insect in 1957 (Muehlbeier, 1958).

To further our understanding of ancient climates and their fluctuations for the ecologic implications they may carry, there is a great need for intensive regional study of pollen profiles and tree rings. The practicability of determining pollen profiles in certain of the deposits of the southwest, which are characteristically non-peaty, already has been indicated by Sears (1937).

There is an abounding need to develop additional methods for measuring weather phenomena so that weather-station data will be ecologically more useful. Can a "duster" be measured simply and objectively as to density and effects? In addition to the present temperature data, would not the duration of extreme temperatures be of high significance? According to Liebig's Law of the Minimum as restated by Taylor (1934), it is the extreme which may be critical — life is adapted to means.

In the Southern Great Plains, there is an enormous need for geohydrologic study. Aquifers need to be mapped as to their extent; and their capacities, drainage and rate of replenishment need to be determined. In the more arid regions, for example, aquifers lack a high capacity for perennial yield owing to the low rate of replenishment. ". . . the ground water reservoir under a 6700-square-mile area in the Southern High Plains of Texas is estimated to hold more than 5 times as much water as Lake Mead . . ., but its annual recharge is less than 0.5 percent of the annual inflow to Lake Mead," (Thomas, 1955). The implication here, at this time, seems plain. Means need to be developed to reduce or even eliminate waste of precipitation. The possibilities for increasing water storage and increased efficiency of use certainly have not been exhausted.

Work in palynology, paleoecology, pedology, dendroclimatology and archeology needs greatly to be increased in the region to develop the most complete picture possible of ancient successions of climate, vegetation, wildlife and man; and to investigate with the greatest intimacy the relations of all ancient life to the paleo-environment in terms of adjustment to change and in terms of resource use. Work likewise needs to be greatly expanded concerning the present environment and its use as to ecology, pedology, climatology and geohydrology.

An interdisciplinary approach is plainly indicated. At a symposium

level, the helpfulness of this kind of an approach has been admirably demonstrated in two recent instances, one concerning early man (McCurdy, 1937), and the other concerning Pleistocene research (Symposium, 1948). The Pleistocene has been reviewed further in a most edifying manner upon an interdisciplinary basis (Comm. on Interrel. Pleist. Res., 1949). The results of so broad an interdisciplinary approach will require careful coordination and interpretation as an integrated whole. And finally, it will be of the utmost importance to relate this information to the regionally-developing economy and pattern of culture.

Attacking a problem of the magnitude indicated here upon an avocational basis truly would be puny! It has already been pointed out by Sears (1953) that: "Most of the working ecologists today are obliged to regard their research as an avocation from teaching or administration." Commendable and contributory as such endeavor is, it is not a sufficient attack against major problems. The presently recognized research needs concerning the Southern Great Plains region are formidable indeed. An organized and concerted broad approach is indicated. At least two facilities now lacking will be required. First, it will be necessary to set aside an area large enough to be reasonably representative of the region. Here long term basic studies and experiments will be carried out. There is an enormous need for such a facility for studies which lend themselves well to localization, and for the many studies which need reference to a base datum. This lack and its correction has been urged for many years for the American grasslands as various writings of Shelford, Hanson, Vorhies, Kendeigh and Coupland attest. In a presidential address to the British Ecological Society, Tansley (1937) pointed out: "One of the most troublesome and irritating hindrances to ecological observations intended to serve as a basis for the study of successional change, and, therefore, having to be spread over a series of years, is the liability to interference with or destruction of the vegetation of the area under observation by such events as clearing, felling, draining, gravel digging, change of ownership, or development." Incidentally, Great Britain already has a Grassland Research Station at Stratford-on-Avon; and Holland has an Institute for Ecological Research at Arnhem.

In addition to being reasonably representative of the Southern Great Plains, a central and accessible location is desirable as is also a favorable pattern of land ownership. These conditions appear to be met admirably in the region where the five Southern Great Plains states come nearest to having a common area of contact, namely, the northwestern Panhandle region. There are in this region tens of thousands of acres of land in federal ownership (Comm. on Agric., 1955). Certainly it is of pertinence to call attention to the fact that these lands found their way into federal ownership as a consequence of the distress associated with the protracted and severe drouth of the 1930's.

In addition, in Cimarron County, Oklahoma, there are some 242,000 acres of state-owned land — about 20% of the total area of the county. Out of the combined acreage of federal and state-owned land present in the common region of the five states, and to the extent this acreage is not already encumbered with priorities more urgent, is it wholly unreasonable to seek the dedication of some three million acres or so as an ecologic research area for the Southern Great Plains? This sounds huge, but it represents only 2.3% of the area of the Southern Great Plains as estimated by Savage and Costello (1948). Hanson and Vorhies (1935) estimated that originally 1903 million acres of the United States was grassland. Of this total, 3 million acres represent but 0.16%. Is this an exorbitant amount to dedicate to basic ecologic research on the broad basis indicated above, when it is recalled that in the United States this is an economic hazard region of the first magnitude?

If this proposition, at least in its broader aspects, does find favor:

1. There should be no thought of discontinuing grazing upon the lands so dedicated. Grazing is a natural prairie process. It should not, however, be permitted to become destructive.
2. Representative samples of natural areas will need to be set aside. These will include sites ranging in area from 40 acres to a square mile, and which, like sea level, will provide a base datum for reference purposes.
3. Since the region is traversed by the "Cimarron Cut-off" or "Jornada" of the Old Santa Fe Trail, no opportunity should be lost to develop the historical interest associated with it. It was the first overland commercial link with the Mexican provinces in the Southwest; it was a military road over which troops under Doniphan marched, and it was a trail traveled by adventurers. It has experienced toil and hardship in abundance.

Many of the old landmarks, since they were physiographic features, are still to be seen, as are also long stretches of ruts left by the old wagon caravans. Visiting the Old Trail, tramping over it, sandwiched between prairie and sky, and camping at some of the old camp sites should engender at once a deep respect for the toilsome wayfaring of the early traveler, and an increased sense of meaning of Americanism. It should inculcate a sense of freedom possible in vast space and impossible in either city or forest. "DON'T FENCE ME IN!"

The second major facility requirement is a physical plant. This will need to provide laboratory as well as office space. A museum devoted to the natural and cultural history of the Southern Great Plains also will need to be included. The museum will serve equally both research and education.

To summarize, a recent paragraph by Sears (1953) seems most appropriate.

"The role of general ecology, viz., a sythesis of plant, animal, and human ecology to conservation [and to land use]* is comparable to the relation of physics to engineering, or biology to medicine. There is at present no focal center for this basic work, comparable to the Battelle Institute. A properly staffed and equipped Institute of . . . Ecology, where records may be assembled and preserved, problems assigned and solved, and information disseminated, is urgently needed."

It is here proposed that steps be taken at once

a) to negotiate for the dedication of 3 million acres of land in the Cimarron River - Santa Fe Trail region of the Southern Great Plains to be known tentatively as the Old Santa Fe Trail National Area; and
b) to negotiate for the establishment of an adequate and appropriate physical plant — The Southwestern Institute of Ecologic Sciences;

— all of this to stimulate and facilitate regional research and education, in the interest of an improved human welfare.

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* Brackets mine.

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