ties and attempt to understand the bases of life of all who share the planet with us. Until expert knowledge of existing realities is available we shall not find those sought-for understandings of the world's peoples that are required to ease existing tensions. A rational change in relationships will not come by capricious action or through ignorance or provincialism. If we really understand how and why humanity is compartmented in its several regions, we shall find adjustments less difficult to make, even though we are at times oppressed by the complexities. The earth is a vast reservoir out of which man dips power. There is unequal access to that reservoir: the earth's benefits are unevenly distributed and, in addition, as Professor Penck has phrased it, "There is no land of unlimited resources." This is due in part to what we call the geographical layout. In part also it is due to the voltage of man's own mind, ever changing the significance of a given environment, searching out new advantages, developing new technical skills, seeking balance or proportion in community, regional and national life, extending the boundaries of knowledge, and adapting the earth and humanity to satisfy material and esthetic needs. To take an example from a single field: not always are desirable mineral deposits accessible—witness the geographical disposition of the coal beds of China; nor are they always required at the moment—witness the vast iron-ore deposits of Brazil. We have begun, but in no sense finished, our regional inventories of fact about the resources of the earth, the uses which we may make of them, the mutual adaptations. Nor has any one yet been able to draw a clear line of distinction between matters under domestic control and those which can never be used rationally and fairly except through international consultation and agreement.

In Professor Romer's notable address at the opening session of the International Geographical Congress at Paris in 1931 is this striking challenge: "Would that this notable assemblage were evidence that geography is officially recognized in public life and national questions as an important subject." In the three years that have elapsed since this statement was made the world has passed through a period of strain that has suffered directly or indirectly every community wherever situated. In the face of local as well as world-wide tension, intelligent men in every country have given much more thought than formerly to some of the fundamental bases of life. Whether or not we deplore the policy of national isolation and self-containment, each country has felt it necessary to examine in detail its resources of every kind. In this examination geography has played a notable part. Were I to name those who have contributed to the discussion of material resources, and how to improve our use of them, I should be required to mention most of the professional geographers of the world.

That we have met in such number, under such favorable auspices, for the discussion of a wide range of both theoretical and practical questions is evidence of a great community of interest with respect to the earth and man's relation to it. Forty-three nations are represented in this assemblage. There is promise of good attendance upon all the sectional meetings and helpful discussion. I venture to say that through the interchange of thought that takes place here we shall be better able to return to our several countries and do our part in community life as well as in research and education by more intelligent assisting the never-ending process of adaptation of means to end in our use of earth's gifts.

SHELTERBELTS—FUTILE DREAM OR WORKABLE PLAN

By RAPHAEL ZON
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THE President's vision of a belt of forest trees, stretching through the Great Plains from North Dakota to Texas, caught the popular imagination as no other forest enterprise in recent years. The idea, suggested at the time when the Middle West had been suffering for several years from severe droughts and dust storms, was dramatized by popular imagination and newspaper publicity into a grandiose plan of changing the climate of the entire plains region, and eliminating droughts and dust storms through the planting of trees.

The plan, as popularly visualized, called for regimenting the trees into uninterrupted and undeviating parallel forest strips, 8 to 10 rods wide, rigidly spaced one mile apart, irrespective of topography, soil or direction of prevailing winds. This naturally brought forth some skepticism and occasionally outright condemnation of the plan. As a matter of fact, the Shelterbelt project, stripped of the exaggerations of its friends and the misinterpretations of its opponents, resolves itself simply into concentrated forest planting within a comparatively narrow belt some 100 miles wide and 1,200 miles long, in that portion of the Great Plains where climatic and soil conditions make

tree growth possible and where such plantations can benefit existing agriculture.

As a result of intensive exploration by the Forest Service of the climate, soils, natural vegetation, existing shelterbelt plantings and agricultural conditions of the region, the boundaries of the 100-mile belt where tree growth is possible and desirable have been delimited. As shown on the map, the center of the Shelterbelt roughly follows the 99th meridian, touching Devils Lake in North Dakota, Mitchell in South Dakota, Lexington in Nebraska, Kinsley in Kansas and Mangum in Oklahoma. The western boundary of the belt coincides closely with a line of average annual rainfall of 15 inches in the north and 22 inches at the southern end of the zone. Higher rainfall is needed farther south to compensate for the greater evaporating power of the air.

West of this line, extensive planting of shelterbelts is considered hazardous, because of the low rainfall, difficulty of establishment, short life, poor survival and adverse soil conditions. West of the proposed boundary is a region which has a relatively large proportion of submarginal land. Such land should best be converted to grass and a simpler form of use, such as grazing. The reestablishment of grass in this submarginal land is admitted to accomplish one of the purposes which shelterbelts are designed to accomplish in the farming region—soil protection. There would be little for the trees to protect in that area, and the trees themselves would develop little more than as bushy growths, except in depressions where their effects as windbreaks would be negligible.

The western boundary, however, does not mean that forest planting in all cases can not be successful farther to the west. There are shelterbelts growing well in some places in eastern Colorado, Montana and Wyoming. Nor does it mean that forest planting can be attempted on all soils within the belt itself. The boundaries merely delimit an area within which forest planting offers the *best* possibility of success when soils, rainfall, type of farming and urgent need for shelterbelts are considered.

The main purpose of planting shelterbelts is to provide protection to farmsteads, agricultural crops and cattle against the hot desiccating winds of summer and the cold blizzards of winter. The greatest benefit of shelterbelt planting may be expected when it is superimposed on an already existing agricultural economy as is found within the proposed belt. This, on the whole, is a region of fertile prairie soils which, with normal rainfall, is an important part of the granary of the United States. Shelterbelts should help to stabilize this agriculture and leave it less at the mercy of the elements.

East of the proposed shelterbelt, conditions for tree growth are more favorable, agriculture has been long established there, and many groves have already been planted by the farmers themselves. This will undoubtedly continue to be the case. However, the area designated for planting must be considered largely as an initial center of work, from which planting can spread both west and east of the boundaries when conditions warrant such an expansion.

One of the questions generally asked is, "Can trees be made to grow in the Great Plains?" This region comprises, roughly, one third of the total continental area of the United States. The precipitation over this region ranges from some 30 inches in the east to 14 inches in the foothills of the Rocky Mountains. It is composed of a great variety of soils, ranging from sandhills to alkali and clay-pan lands, and from true plains to rough broken topography. It stands to reason, therefore, that trees can not be successful grown everywhere throughout the Great Plains region but only in those portions of it where rainfall and soil conditions are not prohibitive.

Even within the boundaries of the belt, the character of the soil may either preclude forest planting altogether or dictate variations in the manner of planting. Within the belt there are roughly some 114,700 square miles of land. This can be classified, according to soil and suitability for shelterbelt planting, as follows:

66,400 square miles of fine-textured soils—so-called "hard land." Generally good agricultural land but not all suitable for forest planting. Thus:
- 36,700 square miles—uplands, shelterbelt planting difficult.
- 24,900 square miles—principally in the eastern part of the belt, well suited to shelterbelt planting.
- 4,800 square miles—clay-pan land and alkali basins, unfit for any tree growth.

30,700 square miles—mostly sandy loams, good agricultural land, all favorable for shelterbelt planting.

13,000 square miles of "breaks" or rough land. Of this:
- 5,000 square miles—favorable for shelterbelt planting.
- 8,000 square miles—difficult to plant.

4,600 square miles of sandhills well suited for forest planting in solid blocks.

Of the total area, some 57 per cent. lends itself to shelterbelt planting, about 39 per cent. is difficult to plant, and 4 per cent. is entirely unfit for planting. It is evident, therefore, that there can be no continuous parallel forest strips, but each planting must be adapted to the soil conditions of every farm and

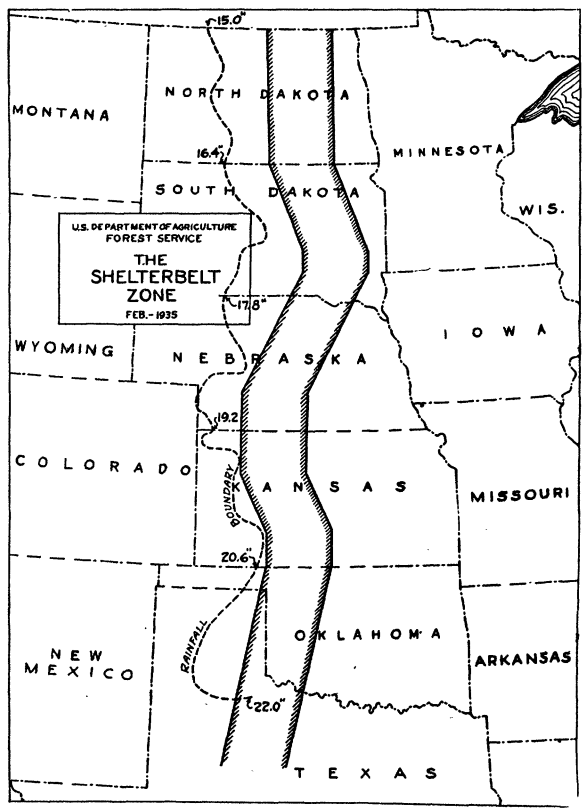

FIG. 1

oriented to the damaging winds prevailing in each locality.

The sandhills, which present the most favorable conditions from the standpoint of moisture and on many of which the ground water is within reach of trees, lend themselves best to planting in solid forest blocks. A good illustration of such planting is found in the sandhills of Nebraska, where the Forest Service has planted successfully some 31 square miles. About 410 square miles have recently been authorized for purchase in North Dakota for this type of planting.

Planting in the "breaks" and gullies will be largely for the purpose of conserving water and checking soil erosion. It will usually be confined to the slopes and active gullies and will follow narrow ravines. On the "hard land," planting will be in the form of windbreaks around farmsteads and schools, or in the form of narrow strips of shelterbelts around fields.

The best answer, however, to the question whether trees can be grown successfully in the prairie-plains region, is that trees *do* grow well in many parts of the region. Shelterbelt planting in the Great Plains states is not a new undertaking. It began with the earliest settlement in the region, when many pioneers brought trees with them in their covered wagons. There has always been an instinctive desire on the part of the dwellers in the treeless prairie to create some protection, by means of windbreaks, for their homesteads. Beginning with 1873, and in some states even earlier, the Federal Government sought to encourage tree planting by granting homesteads of 160 acres, on the condition that 10 acres be planted to trees. Later, the Federal Government, through several bureaus in the Department of Agriculture, began to distribute planting stock to settlers for use in demonstration plantings, and has given advice on the selection of species, methods of planting and care of trees. Likewise, most of the prairie and plains states have encouraged, through their State Forestry Departments, the establishment of shelterbelts by the farmers. These plantations, in spite of rigorous conditions, have on the whole shown good growth and survival, and as a result of these combined efforts the landscape of the plains is now dotted by numerous planted groves of trees. A survey last fall through the six plains states of North and South Dakota, Nebraska, Oklahoma, Kansas and Texas shows that to-day there is on an average one half acre of growing shelterbelt for every square mile surveyed, a larger proportion being in the three northern states. With the large number of species now known to be suitable for dryland planting, and with better knowledge for maintaining the plantations, there is every reason to believe that future planting, conducted in the light of experimental evidence, should prove more successful than in the past.

Another question often asked is, "What will be the benefits from shelterbelts?"

Whether shelterbelt planting, if carried out on a sufficiently large scale, will ultimately affect the climate over a wide territory is at present of purely academic interest, and proof of such an effect is not necessary to justify shelterbelt planting. There is ample evidence, supported both by scientific records and every-day experience, that shelterbelts have a local effect in reducing the wind velocity. This mechanical retardation of wind movement is responsible for a whole series of effects. It lessens evaporation from the soil immediately adjoining the shelterbelts, reduces the transpiration of crops growing under the protection of the trees, prevents blowing of the soil and keeps snow from being blown off the fields into gullies. The aggregate effect is the more complete utilization of the precipitation. Because crop failures often occur in the course of 24 to 48 hours of dry, blistering winds, the presence or absence of shelterbelts during this brief critical period may determine the fate of the crop.

To make the shelterbelts most effective, it is essential that they be flanked with low shrubs or contain some undergrowth. There are many native, drought-resistant shrubs, such as wild plum, caragana, Rus-

sian olive, sumac and choke cherry, which serve admirably this purpose, and at the same time have high value in furnishing food as well as protection for game, song and insectivorous birds. Alternation of forest strips with cultivated fields combines ideal conditions for the conservation and propagation of upland game birds, which may bring the farmer some cash return if properly handled.

Tree planting on slopes of gullies will reduce rapid surface run-off and check soil erosion. As a means of conserving the moisture in the soil, shelterbelts, under certain conditions, may be as effective and less costly than the construction of dams on streams and dry gullies.

Above all, however, shelterbelt planting will make living conditions more comfortable and will add much needed variety to the monotonous prairie landscape. Probably the social benefits from windbreaks will be as great as the physical. If, by means of tree planting, agriculture may be made somewhat safer in a region subject to periodic droughts; if by breaking up the extremely large wheat fields, a diversified agriculture can be encouraged; if living conditions can be made more attractive by planting trees around farmsteads; then the still primitive and hazardous existence in the plains region will be raised for thousands of settlers to a higher level of permanence and stability. It will mean creating in the semi-arid region a belt provided with the amenities of a higher cultural life.

Shelterbelt planting is only a part of a broader plan of water conservation and erosion control for the entire Great Plains region. The "black blizzards," for instance, may be mitigated but can not be stopped by shelterbelt planting within a narrow belt 100 miles in width. These dust storms originate farther west, where the original sod has been broken up by the plow. It is only by withdrawing certain areas of the western plains from crop production, returning them to grass and using them for controlled grazing, that the causes of dust storms may be largely removed.

To bring about the desired improvement in the physical and economic condition of the region, a coordination of effort by the various public agencies interested is essential. It will involve land retirement, controlled grazing, diversification of agriculture, water conservation by building ponds, shelterbelt planting, strip cropping, terracing, development of new varieties of cereals and soil-binding grasses and a rationalization of land valuation and taxation.

SCIENTIFIC EVENTS

COOPERATION BETWEEN THE CHEMICAL SOCIETIES OF GREAT BRITAIN

THERE has recently been circulated to all members of the Chemical Society, the Institute of Chemistry and the Society of Chemical Industry, according to *Nature*, a draft agreement in regard to cooperation. The adoption of the agreement is unanimously recommended by the council of the Society of Chemical Industry and the draft agreement was published in *Chemistry and Industry* on March 15. The agreement provides for the establishment of a fund to be administered by a Chemical Council consisting of three members nominated by the council of each society, together with three representatives of industry, coopted in the first instance on the nomination of the Association of British Chemical Manufacturers. The objects of the fund are the allocation of grants to the constituent bodies for the coordination of scientific publications, promotion of research, maintenance of a library, etc. Complete freedom of action is reserved to each constituent body in respect of the matter it publishes. The management of the library of the Chemical Society is delegated to a joint library committee, and contributions to the net annual maintenance expenditure are to be borne by the constituent bodies in proportion to their membership, with due allowance for overlap. This involves, for example, an increase in the contribution of the Institute of Chemistry to £654 and from the Society of Chemical Industry to £448. The agreement is for seven years and thereafter to continue for successive periods of three years, subject to right of withdrawal on giving one year's notice at the end of any period. If the agreement succeeds, it is anticipated that means of reducing subscriptions to the three organizations will be found.

CONFERENCE OF REPRESENTATIVES OF AGRICULTURE, INDUSTRY AND SCIENCE

DR. FRANCIS P. GARVAN, president of The Chemical Foundation, Inc., has announced that a joint conference of representatives of agriculture, industry and science will be held at Dearborn, Michigan, on May 7 and 8.

In addition to Dr. Garvan those joining in calling the conference are: Edward A. O'Neal, president of the American Farm Bureau Federation; Louis J. Tabor, master, the National Grange; Clifford V. Gregory, chairman, National Agricultural Conference.

The purpose of the conference is to survey the variety of farm products which through organic chemistry can be transformed into raw materials usable in industry, and to develop a plan for the joint cooperation of agriculture, industry and science for promoting