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THE PIONEERING PROCESS[1]

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So long as men "looked for a sign" the way of life was easy to find. Pioneer colonists took what the land offered: "That with their miseries they opened a way to their new-lands." This was man the wayfarer and burden-bearer, not man the destiny-guider. At length science began to interpret the physical world round about—its amplitude or scale, its great variety of environments, its favored areas, the breeding grounds and the courses of the storms, the way of the currents in the sea, the natural food supplies, and finally the improvements that could be made here and there by inventions and by technical processes that grew out of the attempt to apply scientific discoveries to man's own well-being.

Locke held that "it is easier to believe than to be scientifically instructed." Even now, in the full morning of the scientific day, crude belief is the basis of most of our human acts and relationships—a hunch that a given law, condition, social or economic arrangement is better than some or any other. The "method of science," which means the experimental method, is good enough for all but the affairs of men. In a sense this has been fortunate, for civilization could scarcely have had a beginning if the law of demonstration had always held sway. What was first needed was a rough-hewn scheme and a faith-yielding people. As life got more complex it became more troublesome to think about and the effects of a given act harder to anticipate and to measure. Always men have sighed for the good old times, meaning the simpler times. Even among "scientific" men, the *curiosi,* the individual is as apt as the rest of man-

[1] Address delivered at the annual banquet of the Society of the Sigma Xi, Yale University, March 19, 1932.

kind to be credulous and faith-giving outside his own bailiwick. Johnson's Dictionary of 1799 defined the word "scientifick" as "producing certainty." How we wish it did! After observing the part of science in the social forces of our day we are tempted to define it as "producing uncertainty." Strange mixed harvests of thinking and guesswork and faith go into the making of civilization!

In creating the elements of civilization it was discovered that the greatest single fact about humanity—despite all its fears and hesitations—is its willingness to advance across the border of experience: "and yet men strive to find a way." Every generation supplies its quota of men who question and venture and who are not dismayed by the failures and fears of others. The world is on a hinge and they want to swing it. Venturing mankind had to learn, however, that social evolution progressed only so fast as man could discover and control extra-human energies and apply them socially without smashing society in the process. Great as was the effect upon trade of the ocean-going ship, its greatest effect was in making possible new or greatly changed social and political systems through economic betterment that depended upon swifter and cheaper trade by sea. A full-rigged ship under sail develops at least 500 horse power, or 6,000 man power. These figures were of tremendous importance when they first became applicable, because the development of such unheard-of power required but a handful of men: two men can steer a full-rigged ship and twelve men furl her largest mainsail. Kingdoms and empires and economic and social systems came to be built upon this new form of extra-human energy, the ship.

The magic of science, its ameliorating influences upon life, the thousand and one conveniences which it has supplied—these are to-day but the elementary aspects of the situation. Science now presents a more serious aspect and is bound to more fateful consequences. In our time we have seen it as a sort of Trojan horse out of which have come arms and armaments and poison gas, and new opportunities to enslave and prey upon and destroy society. It was contended by Bagehot that it is the "highest genius of government to evoke new power." The power that he had in mind was the power to shape the economic and political systems of the day, the power really to guide the destiny of a nation. How tragic that the evocation of that power has lagged so far behind material things and powers that have profoundly changed human relations.

It is from such a standpoint that we may perhaps most advantageously look at those thrusts of culture into the undeveloped lands by a process we call pioneering. These thrusts have been largely haphazard in the past because our knowledge of the new environment of the frontier was both unsystematic and incomplete. The land-tilling pioneer had to be his own scientist. It was the "look" of the soil and the native vegetation upon which he largely depended. The pioneer has been continually gambling on the earth, at times confident that she would return a harvest, yet again and again disappointed in her, cursing her and then returning to gamble again. That is why the pioneer has been called a "luck-hunter." The trick was to learn "when to labor and when to wait without losing courage."

The forward thrust of population into new land means not merely a movement of people. It means also the extension of a system of agriculture as well as systems of economics and of social organization. The earth can not be viewed abstractly by the colonizer. A piece of land is not merely something to be judged according to its capacity of producing a given crop. The system of tillage that may be employed comes to have as much to do with the result as the rainfall. Great distance from market may prevent the exploitation of even the richest soil. The remoteness of a given region may make it impossible to maintain contact with neighbors and to participate in community life. These we call matters of "social density" and "economic density," and there are limits of toleration to both. At least this is true for the greater number of people, though account must also be taken of the pioneer of the Voortrekker type whose "neighbors' smoke shall vex his eyes" and whose chief purpose between birth and death seems to be to increase the distance between himself and a railroad.

Civilization is like a city—it is always being rebuilt. Always "in the center shall come another word," as one Maya glyph is rendered. This means that the outward thrust of civilization constantly changes its objectives, its degree of employment of the instruments of power and even its spirit. The history of pioneering is a history of mankind advancing into new territory by adapting instruments and attitudes and systems. If the pioneer of to-day expects success he must be responsive to world economic demands, and this requires him to have a definite production technique applied in a specific geographical environment whose possibilities have to be discovered one by one through experimentation. This has always been true to some extent. It is almost universally true of the remaining pioneer lands of the world because those lands are not always of the best. Most of them are marginal lands where the climatic extremes have an exceptionally wide swing, where the soils are notably different from those in regions that have "normal" climatic conditions. They lie on the colder, the hotter, the drier, or the more

distant borders of the areas of denser settlement. On the one hand they are bordered by belts of denser farming population, on the other hand by grasslands requiring an economy of their own and occupied by a scattered population.

It would be relatively simple for man to occupy the marginal lands in which modern pioneering goes forward if the advance were made by twos and threes and no thought given to the standard of living. As a matter of fact, the advance is made by communities, by groups of people, by colonies, or, as in Manchuria, by a swarm of humanity. Among all these there are two types, broadly speaking: first, those who go from machine-equipped communities with high standards of living; and, second, those who go from a land of hoe culture and tiny farms where there is small command over instruments of power. To the latter class pioneering is not in a high degree experimental, because the only question that is asked is whether human labor applied to the soil through a hoe or a plow will raise a crop that will sustain life and provide a small margin for purchases at a local trading center. To the former type—the machine-equipped pioneer—the question of a mere living is but one of a number of questions that confront him. He has in mind a standard of living. He does not merely live; he will try to live in a certain way. He looks not merely at the land under his feet and at the sky above; he looks back also to the communities which he left behind and he sees that government does things for communities. It provides them with railways and telegraph lines, with quick mail service, with schools and with marketing facilities. If not directly, at least it makes possible their doing or permits them to be done or encourages them to be done.

Nor do these things always depend upon the initiative or the demand of the pioneer. Government itself takes a hand in the pioneering process, to encourage it, to persuade more people to live upon the land, to provide a broader basis for the industries of its cities by extending the acreages of farms and the number of farmers, by making life upon the frontier *attractive* to the immigrant. Thus, Argentina and Brazil have at times attracted European migrants by the offer of free seed, free agricultural implements, and land at a low price with easy terms of payment. Organizations exist to help the settler. In London there are the Oversea Settlement Department, the 1820 Settlers' Association and others. In places in southern Africa the settler is received for a year upon an established farm as an apprentice to learn how to till the ground; in fact, to learn the whole business and technique of farming under local conditions. Government has taken a hand in group settlement in Western Australia, assisted migrants with free steamship fares, assured them a weekly wage, and offered them newly cleared land equipped with farm buildings at a reasonable price. Canada has maintained an alert attitude toward the streams of settlers that have flowed through her eastern ports and has sought to put them upon the land under conditions that would guarantee permanent occupation of new territory and types of community life that would make the new settler a part of Canada in a reasonably short time, a process known as Canadianization.

Technical studies have sometimes gone ahead of the pioneer, but more generally these have been of the reconnaissance type. The occupation of the new land has been experimental by the farmer himself. Here willingness plays a large part—willingness to experiment. In general, the city dweller wants his system set up for him. The farmer who has come from a given community to the border is more willing to try out a new scheme, accept for the time being a lower standard of living, and show some confidence in the future growth of the region. There is a great deal of pushing forward on all frontiers by the slow method of occupying land that is "just over there," with but little change in the culture system. The tillage is the same, the machinery required is the same, the crops are the same as those already known. Or, if changes are required, they are moderate. The old friends are near by and accessible. Such a movement asks no questions of the statistician or the scientist. It relies upon its own judgment. The men involved in it would scarcely look at a soil map. And it certainly scans no far horizon for opportunities that are or may be better than those near at hand. This type of advance is taking place wherever pioneer lands are available and in spite of a world-wide depression in agriculture, difficulties of transport, and apparently uneconomic distances to market.

Since the world war both science and government have concerned themselves very much more than before with questions arising out of the flow of population from country to country. The first general conclusion in the countries of the new world was that the flow from Europe should be greatly diminished. The streams of population were thus backed up at their sources, with a certain amount of international ill-will as a consequence. The damming process permitted the governments of the newer countries of the West to examine their economic and social structures and to determine how far population need be admitted at all or, when admitted, what disposition of it could safely be made. It seemed almost axiomatic that population could be admitted at almost any given rate so long as it was placed upon the land, for increasing acreages of tilled land were taken to mean increasing national strength. No one looked forward

to a day of pronounced agricultural overproduction the world around. No one had anticipated so great a disproportion between food production and food consumption.

The occupation of new land thus became the business of government, and the policies in relation thereto came to be intimately connected with national immigration policies. More and more we call our earth and its peoples "a world without frontiers," but this has reference to the flow of culture chiefly. As a matter of fact, we are more conscious than ever of political frontiers, and as for the pioneering border, that is now a matter of public and international concern. The "border" is not merely a fringe where people can be left to take care of themselves. We must incessantly strive if possible to foresee the consequences that will or may follow upon the adoption of any given policy. It is stupid to see only the facts that lie obviously before us. Science tries to be not merely responsive to events which have already happened but "creative of events which are about to happen."

The population problem becomes even more complex when we recall the extent to which land has been abandoned throughout our own country, communities left to rust out, and land to revert to perplexed state governments. We have discovered that it is unintelligent to grow everything that can be grown in a given place. More and more, agriculture is differentiating the earth. A thing tends to be grown in the place where it can be grown best, that is, most economically. There is surely no need of new farms unless they can produce more cheaply than the farms that are now in use.

Definitions have but a minor part in the process, in spite of the need for the application of principles embodied in definitions. The very basis of the state, said Confucius, was in "getting the words right"; but there is a higher law—making the words live. The American traveling in Europe has need for this sustaining truth as he takes his morning coffee, for the custom in that land of unhappy breakfasts is to boil and boil and boil, and so long as the grounds discolor the water the discolored water is coffee—by definition! It is not mere definition or technique but the living edge of experience that is required upon the border of land occupation. New communities have a noteworthy flexibility of spirit, a power of adaptation of social forms to the requirements of new situations. Whatever the physical likenesses of pioneer regions, each has its unique social and economic qualities, its distinctive peoples, its own rate of flow of life in new channels.

To one accustomed to think that pioneering is ended in the United States these may appear to be remote questions applicable to Siberia and Australia and the Canadian Northwest, but having little significance in our own land. This position would seem to be fortified by the declaration of our Bureau of the Census in 1890 that "the unsettled area has been so broken into by isolated bodies of settlement that there can hardly be said to be a frontier line." In consequence, the extent of the unsettled area and the line that marked the border of advancing settlement were no longer emphasized in the census reports, which led later commentators to think that frontier conditions had passed and that the years immediately preceding 1890 marked the end of pioneering.

There are two important corrections to be applied to this simple concept. In the first place, the line between settled and unsettled country was drawn between population densities of two to the square mile and less than two, when as a matter of fact there are large areas of permanently settled western country that have less than two to the square mile, if (like the census of 1890) we take counties and smaller civil divisions as units and average the population. The second correction is still more important. The removal of a line from the map merely because that line has ceased to advance into unsettled country does not mark the end of pioneering. For pioneering is a process of experimentation, not merely an advance, and so long as the experimentation continues so long do pioneering conditions persist. I was first made aware of the existence and significance of long-continued frontier conditions while engaged in field studies in South America in 1907, in the course of the first Yale South American expedition. Again in 1913 I visited some of the oldest towns in South America on both the eastern and the western borders of the Andes in Argentina and Chile. Among them are Salta and Copiadó and the then isolated town of San Pedro de Atacama in Chile. In the frontier communities tributary to these towns one could still find many characteristics of frontier living. Here was what might be called a crystallized frontier type of life.

The same process of crystallization has taken place in our "zones of experimentation" in the Far West. On every hand one is made aware that he is on the border of the tilled land, not within the core. In core areas the rainfall may vary considerably and crops may vary accordingly. But at least there is some crop. By contrast the border of the tilled land is everywhere characterized by climatic extremes. These extremes do not mean merely a change in the output of grain and other products: they may mean a complete failure to produce anything at all from the ground. The problem of occupation of such areas is therefore expressed not merely by saying that there

will be some years in which there is little or no crop and other years in which there will be abundant crops—perhaps sufficiently abundant to enable the farmer to accumulate reserves that will tide him over the dry years.[2] No, the problem is much more complicated than that because the moment there is a technological improvement in the methods or the machinery of farming there may be a very great change for the better or for the worse in the economic condition of the farmers in a given zone of experiment. That is a first possibility. A second possibility is that world production will change very greatly—now it will be high and again it may be very low. According as it varies it will affect the market price. This means, further, that farming in the zone of experimentation may be affected by world market prices as profoundly as by either years of abundant rainfall or years of drought. Lastly, there is a variation in rainfall that may be combined one way or another with the two variations noted above.

All this means that we have a permanent zone of experimentation along the border of the tilled land and that population is still advancing and retreating in local areas and still experimenting with the specific qualities of their land and their community and market possibilities. They are looking for new tools and new knowledge that will enable them to possess the land more securely. They are still inquiring how far it is profitable to advance into new climatic regions or how far they have already exceeded the limits of permanently successful occupation. Our successive land laws have recognized the need for units of land of varying size, subregion by subregion, but the application of the law has been very rough and needs to be refined on the basis of land classification studies still in progress. Insurance against extremes of climate may be desirable in the future, but what insurance can there be against something equally important, the wide fluctuation of the market price?

These are but indications of the categories of inquiry and fact in which the geographer is interested in his intensive study of the zone of experimentation called "the pioneer fringe." Economic, historical and sociological problems are also involved. Where earlier students saw the line of pioneering halted and a condition made static, the geographer sees a continuing dynamic. The frontier type of living is in a sense a permanent feature of the life of our western border country. Here the population must constantly experiment, constantly gamble on climate and market price if the land is to be occupied. The man who is unwilling to guess that the rainfall will be sufficient for a crop will never sow his seed and take his chances with rainfall or, rather, with drought. The process of adjustment is endless.

We can not say merely, "Withdraw farmers from the marginal lands and let grazing become the permanent form of occupation." There is no such thing as a "permanent" type of land use on our climatic borders. Moreover, the whole of society and economics is changing constantly. So, too, will the use of the land, and, so long as periods of wet years come on the dry borders and periods of frostless and protracted growing seasons on the cold borders, so long will settlers try their luck again and again, hazard their living on their guess that a crop can be raised, and challenge science to forecast the extremes of climate with which they gamble.

In a wider survey of pioneer lands in other continents we become aware of further complexities in the pioneering process that grow out of differences of race and system. Twenty million Chinese have gathered in Manchuria, first pushed out of the crowded regions farther south, especially Shantung, and later attracted to the fertile acres of the pioneer fringe farther north by the higher standard of living that they were able to win and by the establishment of communities that restored to them to a measurable degree the life they had left behind. Some change in dietary habits had also to be made and new methods learned of raising crops under unaccustomed climatic conditions. At last upon land that was long a "far north" to the Chinese there was developed a vast new political province served by a network of rails, "the civilizing rails," to use Jefferson's phrase. A broad, thinly peopled belt of frontier territory was changed to a field of political strife. A distant border has become a focus of intense international rivalry.

Southern Africa presents a wholly different group of problems. Here the pioneers have come among large native populations as masters who believe themselves capable of exercising power over both white and black and holding the scales of justice evenly at the same time. After the occupation of the southern coastal girdle of more accessible and better-favored land, white occupation spread northward following in recent years interior uplands upon whose summits and about whose borders the white man found it tolerable to live and work despite increasing nearness to the equator. The land was endowed in a number of places with mineral deposits of exceptional richness and value, with the consequence that railways could be supported virtually by mines alone. Railways thus became agents of pioneering, forerunners of

[2] A two-year supply of forage for farm animals is commonly kept "in sight" in the western part of the High Plains of eastern New Mexico ("The Pioneer Fringe," published by the American Geographical Society of New York, 1931, p. 118. In this book and in a companion publication entitled "Pioneer Settlement" are a large number of maps showing the world's remaining pioneer lands).

land settlement. Plantations came into being on both sides of every railway line. Lacking the mine-railway combination land settlement would have been slowed down or halted altogether because the soils of southern Africa are naturally infertile, "desperately poor" in organic matter. Phosphorus is generally lacking. There is also a deficiency and high variability of rainfall over most of the territory. Climatic instability tends to retard settlement and the growth of white population. When there is a swing of rainfall from a wet to a dry phase the effects are not local but widespread, and on the borders of settlement they have again and again been devastating.

Even now the principal crops of the Union are extremely low in average yield, maize being about one third of a crop, judged by American standards. More intensive and diversified cultivation in the favored areas and a greater differentiation of land use has been the result. The country has tended to break up into better demarcated regions with ranching and transitional farming coming in upon the poorer lands. In the high veld of the southern and southeastern Transvaal, for example, the vast farms of an earlier day are no longer the rule. Two hundred to four hundred acre tracts are now common. In the northwestern part of the high veld the rainfall is less reliable and land values are low. Individual holdings are therefore larger—up to two thousand acres. In the Limpopo Valley, still farther north, acreages run as high as ten thousand per individual holding. Always in the direction of uncertainty of rainfall the size of the farms tends to be larger and occupation more unstable. This instability makes its special appeal to legislators, who number among them a large proportion of farmers; and the consequence is possibly "an over-expenditure of state funds to relieve the hardships of the sufferers."

A culture system based upon the plantation has given pioneering in South America a distinctive stamp. In some places the native population was exploited under the institution known as peonage, a mild form of slavery. Ownership of property and land was reserved for the whites, who were from the beginning a privileged class. One effect of the plantation system and an available supply of native labor was that it brought lands under cultivation which would otherwise have been too distant to exploit economically, and it thus provided government with larger and larger acreages of taxable property. Mineral and rubber concessions were found to be profitable devices to secure roads and bridges to outlying districts. Thus the chain of Andean states running from Argentina to Panama contrived to bind their scattered agricultural lands into something like units and to hold isolated population groups together in loosely organized political systems.

The second half of the nineteenth century, the period in which most of the railroads were built, witnessed, curiously enough, a drawing-in of the limits of settlement in many remarkable instances, as men became tied to the new economic system of which the railroad was the symbol and in which time came to be more and more important. The speed of transportation now became an inescapable part of the process of moving goods and men. The United States has no class upon whose shoulders can be dropped so heavy a load as that which is dropped by the South American upon the lowest ranks of his society. He is intent upon maintaining the privileges and luxuries of a class: all is well if these privileges and luxuries are being enjoyed; all is wrong if they are taken away, no matter what the reason may be. In unbroken sequence the concepts that so long ruled Iberian life may be traced through the colonial period and the period of liberation in South America down to our own time.

The plantation system in South America persists in some places because it is economically best for all concerned, while in other places it is a device employed by the landowners for maintaining an essentially aristocratic system based upon land. In cereal-growing Argentina, large landholdings became the rule when Argentina was primarily a pastoral country; they have persisted through the change into a cereal-growing system in which pastoral interests still bulk large. The large landowner really doesn't want to give the small landowner a chance. He wants to maintain his system as he found it. "Agriculture has here become the handmaid of stock raising." Fully one half the grain exported from the republic is an incident to cattle raising. Seeing that his once cheap (and in places worthless) land has increased in value and made a fortune for him, the owner has made up his mind not to part with any more of it. Says Jefferson, "He could get a lot of money for his land if he sold it, but what should he do with the money? . . . He might lose it; and wasn't the value of the land increasing every day? Better keep the land and let the gringo [foreigner, *i.e.* European immigrant] go on working for him."[3]

Coupled with this state of things is the feeling that only members of the upper class are intelligent and responsible. In their view they own the land and govern the community in quite a proper sense. The peon has a station in life akin to that of the peasant in Europe, and the educated Argentine knows the

[3] Mark Jefferson: Peopling the Argentine Pampas, *Amer. Geogr. Soc. Research Series, No. 16*, New York, 1926, pp. 168–169.

culture and economic systems of Europe better by far than he knows the development of the really democratic systems of the New World that he thinks himself a part of. Little wonder, under such a system, that not all the good tillable land is by any means yet occupied. To the untilled acres must be added the economic loss sustained by a superficial cropping of the land.

In the Frontera of Chile we are witnessing to-day the last successful large-scale occupation of new land in that country. The patronage of the government has been extended to new settlers, who in past years have included both Chileans and Germans. Government even went so far as to forgive "obligations that turned out to be unreasonable." This humane attitude may be called "enlightened selfishness," for in the provinces farther north the point of saturation of population density has been approached, and government is obliged to turn to the pioneer zone of southern Chile and to the development of industries based on mineral deposits, enact social legislation of an advanced type, and develop something like a balanced agrarian program.

Where the line of settlement ends in Chile will depend upon the value of the products that the settler can get from the soil and upon the limits of human tolerability with respect to rain and its consequences in muddy roads and shortened seasons of labor. The experience of hardy settlers on many frontiers shows that the limits of tolerability can not be forecast. The Frontera is therefore a region of experimentation in a broad sense. Trees have to be felled, rain endured, and poor communications as well, and specialized production practiced. The environment is new and strange to the colonizing Chilean; and it can hardly appear as the best of earth to the German or French or Swiss immigrant. Government will improve some of the conditions, no doubt, as it has done in the past.

Cast in different form are the settlement problems of the eastern Andean valleys all the way from Venezuela and Colombia, on the north, southward along or near the Andean border, down through Bolivia and Argentina to the Strait of Magellan. On the north are tropical valleys far removed from the highland centers of population in the sense that steep and long grades must be overcome to get products out; and separated on the east by broad stretches of lowland, densely forested, that run to the Atlantic. In the Gran Chaco of Bolivia and Paraguay settlement has pressed forward far enough to bring this once useless land within the international framework. For centuries it was empty land beyond the outposts of settlement; to-day it is the scene of armed conflict between Paraguay and Bolivia and is involved in one of the major international boundary disputes of South America—all because of the value of the Paraguay River as a commercial outlet and the undeveloped resources of timber and pasture that have attracted the attention of political and commercial leaders. Northern Patagonia has for several decades been the scene of increasing colonization by farmers and herdsmen; and in scattered situations in central and southern Patagonia grazing interests have everywhere sought out the better sites.

Without attempting to describe the remaining pioneer lands, we may take a look, in closing, at a professional aspect of the problem of pioneering that may not be without interest to you. It will be clear from a review of the concepts that we have dealt with that "a science of settlement" can not be developed by a single discipline. The moment institutions are taken into account, the moment we challenge a given system, the moment we deal with the actual complexities of the problems of present-day life, we are bound to consult widely. Of necessity the individual is really expert only in a narrow field. It is time that restricts him, not narrowness of spirit or limited outlook. Time is required for that indispensable mastery of at least one technique, or several techniques, that is necessary if one is to make progress in original investigation. But the moment one leaves an area of special expertness and enters a broad field of inquiry like pioneer settlement one must bring experts together. For when the individual attempts to cross over into an unfamiliar field he is apt to drop back to the elementary generalities or concepts of the textbooks. Here it is that cooperation with his fellows enables him to avoid the worst consequences of his deficiency. By this means there is mutual education at a rapid pace of experts who have ideas and techniques, variant and unfamiliar (as between different groups), that it is sought to apply to a problem of common interest.

Cooperative research is not a mere trading of ideas, not just a speeding-up of output; nor is it a new form of magic. It definitely is a means of rendering neutral and harmless the tendency to certainty, the too great simplification of ideas, and enslavement to accepted methods. Through the medium of a common problem it locates the living edge of experience and opinion in related fields. The first results of modern science were considered so beautifully demonstrative that, backed by forensic power, they were made to seem final and complete. The tendency may be offset by getting away from the rules and seeing realities naïvely as well as through the "principles" that embody the generalizations of a single science.

A practical test of the method is now being made

by a group of Canadian scholars who have formed a "Canadian Pioneer Problems Committee," working under the auspices of the American Geographical Society and supported on the one hand by the Social Science Research Council and on the other by individuals, institutions, and bureaus of government in Canada. Two field seasons have been occupied in gathering information first hand according to a well-defined but flexible scheme of investigation set up in the beginning. The successive annual reports of the committee have demonstrated the wisdom of the method, and within a year or two there will appear a number of volumes of results that can not fail to be of importance to Canada as a nation as well as to other countries having large areas of marginal lands which are or will soon be in process of development.

SCIENTIFIC EVENTS

THE ZOOLOGICAL SOCIETY OF LONDON

ACCORDING to the annual report of the Zoological Society of London, as reported in the London *Times*, the assets of the society amount to £177,708, a decrease of £493 on the corresponding figures for last year, but these do not include the capital of the De Arroyave Trust Fund, the chief item in which is a holding in consolidated 2½ per cent. stock of £123,889. The total income of the year was £141,525, an increase of over £7,000 on that of last year. The income from the Regent's Park Gardens was much less than in 1930, chiefly on account of the bad weather during the greater part of the season, but this was more than made up by the income from the new park at Whipsnade, opened for the first time last Whitsuntide. The total number of fellows decreased from 8,430 to 8,307, as the new fellows elected did not balance the number of deaths and resignations.

The gardens are again to be kept open until 11 P. M. on Thursday evenings from June 2 to August 25 inclusive, and the J. H. Squire Celeste Octet is to play during dinner. On Saturdays and Sundays from May 28 to August 28, inclusive, the band of the 65th (8th London) Field Brigade, Royal Artillery, will play in the afternoons. It is regarded as doubtful if the Thursday evening late openings actually cover the cost of the extra attendance and lighting, but they give an opportunity to many persons engaged during the day to see the collection.

Notwithstanding the bad weather, there were only 27 deaths among the animals from tuberculosis, the lowest since 1925, and of these only one was a monkey which had been 11 months in the gardens and had probably been affected before its arrival. Among the mammals bred and reared in the gardens were three kangaroos and wallabies, two opossums, three porcupines, three musquash, four agoutis, four coypus, a yak, bison, Mongolian wild horses, Grévy's zebra, sea-lion, lion, eland, black-buck, water-buck, nylghaie and lemur, four ibex, 10 wolves, four Barbary wild sheep, and six thar. Among the birds bred and reared the most notable successes were four Cape penguins, one macaw, one cockatiel, 20 parrakeets belonging to several species, and 138 budgerigars, including green, yellow and blue varieties. At Whipsnade one wombat, one llama, one yak, one red deer, one fallow deer, two nylghaie, two black-buck, two white red deer, two Chartley and five Highland cattle, and six wolves were bred and reared.

RESEARCH COMMITTEES OF THE SECTION OF HYDROLOGY OF THE AMERICAN GEOPHYSICAL UNION

THE Section of Hydrology of the American Geophysical Union has announced the organization of nine permanent research committees. This section is concerned with the study of the waters of the earth from the time they are precipitated upon the surface as rain or snow until they are returned to the atmosphere or are discharged into the ocean. Each committee is to make an annual survey of work in progress in the field of hydrology which it covers and to maintain contact with the workers in its field. Following is a list of the committees and chairmen, together with brief statements of the field to be covered by each committee:

Committee on Snow: J. E. Church, meteorologist, Nevada Agricultural Experiment Station, and adviser, Nevada Cooperative Snow Surveys, University of Nevada, Reno. The quantity and distribution of the snowfall, the methods of making snow surveys, the melting and evaporation of the snow and the relation of the snow to run-off and absorption.

Committee on Glaciers: F. E. Matthes, geologist, Geologic Branch, U. S. Geological Survey, Washington, D. C. The hydrology of existing glaciers, as distinguished from the work and products of ancient glaciers. The committee is to obtain and interpret systematic records of the advance and retreat of glaciers in the United States, including Alaska; also, related records of the movement of the ice, weather conditions and the discharge of water from the glaciers.

Committee on Evaporation: G. F. McEwen, oceanographer, Scripps Institution of Oceanography, University of California, La Jolla. The rate of evaporation from free-water surfaces, the effects of weather and other conditions that influence evaporation, and the methods of determining evaporation; also, the fluctuations of lakes and their causes.

Committee on Absorption and Transpiration: C. H.