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THE SCOTTISH GEOGRAPHICAL MAGAZINE.

THE DEVELOPMENT OF HABITABLE LANDS: AN ESSAY IN ANTHROPOGEOGRAPHY.

By HUGH ROBERT MILL, D.Sc., LL.D., F.R.S.E.

FROM the geographical point of view the development of a land usually means something more than making the largest possible sum of money out of it in the shortest practicable time. Such "development" as that idea conveys may possibly be the only kind applicable to very remote regions, which could never be made available for permanent human habitation; but for habitable lands, or lands which may become habitable, it is absurd. Looking on the world as not only the home of man, but as subservient in all its phenomena to the welfare of the human race, we may consider the development of any region to mean such a treatment of its natural resources as will enable the land to continue to support its inhabitants as their number increases. In the case of a new land, that is, a region the resources of which are yet unutilised, and which is practically without inhabitants, the problem of development is presented in its easiest form. It becomes very difficult, however, when the density of population approaches the limit at which the means of subsistence threaten to be insufficient: then it becomes the serious problem of the development of old lands. The only case to be considered here is the development of the new lands of the temperate zone; but the possibility of a land growing old and exhausted must always be borne in view. Immediate advantage would be purchased too dear if it involved exhaustion instead of development—killing, instead of feeding, the goose which should lay the golden egg of the future. The question of developing lands becomes complicated in detail, because it involves large economic considerations and difficult distinctions between investment and speculation; but the broad principles are clear enough, and their application may be left in the hands of those whom they practically concern. It

would appear that fortune-hunting is inimical to development in its true sense. A fortune can usually be made through production or speculation by only a few individuals, and almost always by the exhaustion of natural resources or by the lowering of wages; a prosperous livelihood, on the other hand, can usually be secured to a multitude without permanent impoverishment of the land.

The development of a habitable region, which implies the expenditure of labour or capital with a definite end in view, will be considered here from the point of view of civilised mankind in general. Thus considered, it is essentially the process of securing a permanent adjustment of people to the land on which they live—a geographical problem which lies, it is true, at the root of politics, but which is not treated here from its political side.

The natural resources of a region may be broadly divided into two classes, those which occur in the crust of the Earth and are therefore limited in quantity, and those which utilise the sources of energy external to the Earth and are therefore capable of being increased in quantity by appropriate means. The former class includes all minerals, precious metals, metallic ores, coal, precious stones, etc. These form a sort of reserve fund the amount of which in existence cannot be increased, and even if very large should not be treated as if it were inexhaustible. The latter class includes all vegetable and animal products. They can be improved by cultivation and breeding, as well as increased, in favourable conditions, to any desired extent. It includes also such natural sources of energy as the heat and light of the sun, the power of wind and of running water. These resources may be looked upon as income, which cannot be drawn upon in advance, but is always punctually paid, and may in some cases be laid by for the future. As a transitional form between the two classes one may consider such resources as can only be produced slowly but may be readily destroyed. Of these, forests are the best example; if once destroyed, they cannot be renewed without the lapse of several generations, and sometimes not at all.

Generally speaking, the requirements of a civilised people which ought to be met by their own land are (1) material for food and clothing, which come from the reproducible resources of the vegetable world and depend upon soil and climate; (2) material for houses, implements, machinery, and means of transport: these come on a small scale from the forests, but on a large scale only from the substance of the Earth's crust, and their distribution has nothing to do with the present distribution of climate; (3) the power of doing work. This third requirement is of very far-reaching importance, for it has to do with every form of agriculture, of mining, of manufacture, and of transport. The energy supplied by human or by animal power is too little to be of much service in doing work on a large scale. It is true that primitive tribes may do a great deal in the way of hunting and fishing, in cultivating ground and building dwellings, in making canoes and travelling thousands of miles in them on inland waters, all by the strength of their own arm, or the aid of their domestic animals. But neither distant voyages on the ocean nor rapid travel on land is possible without making use of the

larger powers of nature. These may be drawn from the accumulated treasure of mineral fuel, which once exhausted will not likely be replenished, or from the wind, running and falling water and solar radiation, to which for practical purposes may be added the tides and the internal heat of the Earth. The second class of sources of energy may be drawn on freely without risk of exhaustion; and when, in a few centuries, coal and petroleum can no longer be obtained, the work of the world must be carried on by the means which were in use before mineral fuel was discovered, but applied by new methods unknown in ancient times. It is conceivable that economical processes of storing and transmitting light, heat, and power electrically may be invented which will supersede the use of coal even while it is still available in large quantities. The coal-problem, which thirty years ago seemed to be the key to the whole history of civilisation, has now ceased to be a source of supreme anxiety. As yet, indeed, the coal-fields continue to rule the industrial world, and in all industrial countries they are the seats of the densest population. But within the last few years we have seen great industrial centres being formed not only round the giant falls of Niagara, but on the innumerable torrents of Switzerland, Norway, Sweden, Finland, and in the heart of the Scottish Highlands. If the movement of population from the coal-fields may not be said to have yet begun, at least the industrial monopoly held by coal-fields for a century is being threatened by a rival destined to success. It is clear that at different stages of culture or of practical inventiveness different natural resources attain the chief importance and different regions come to the front as the most favoured by nature for the life of the time. The new tendency as regards the sources of power is an eminently healthy one, being towards the utilisation of the inexhaustible supplies due directly or indirectly to daily solar radiation.

If a self-sufficing region is to continue self-supporting an effort should be made to regulate the use of mineral resources so as to postpone their exhaustion, while not reducing the output to such a degree as to hamper the development of the agricultural resources or of industry. The soil, on the other hand, should be treated so as to maintain or increase its fertility, by the ultimate return of all the mineral salts extracted by the crops, and the restoration also of the combined nitrogen removed in the same way. The necessity for this is not at once apparent in virgin soils, but many years of continuous cropping do not elapse without a significant reduction of fertility calling for remedial measures. An ideal state of things results in those places where grain is grown not for export but for feeding live-stock, which, living on the land, return to it most of the valuable salts as manure; and when the animals are exported as preserved meat or meat extract, the bones and waste products of the slaughter-houses are worked up into fertilisers which restore the balance. In the scientific sense it is only the adoption of an advanced agriculture which can be said to develop the land at all, but in the long-run if all the forests are sacrificed to make room for fields, too much agriculture may help to ruin a country. Forest and field should exist together, and in the proper places efforts as strenuous must be made to protect extensive woodlands from fire or reckless cutting, or to replant waste land with

trees, as are usually bestowed in wooded countries on making clearings for farms.

Finds of gold or diamonds have often been of service in drawing population to countries not otherwise attractive, which when developed by agriculture have yielded far more from the fields than from the mines; California and Victoria are cases in point. There is no development possible in working out a small supply of precious metal by the introduction of an army of men, fed for a year or two on imported provisions, and withdrawn as soon as a better-paying field is discovered, perhaps at the other end of the world. For the true development of a country, mines of iron and coal, leading to the establishment of industrial works on a small scale at first and gradually growing with the local demand, are far more valuable than a rush of thousands of diggers to a new gold-field. Naturally an exception to the conservative treatment of mines may be made in the case of mineral resources occurring in countries incapable of being permanently inhabited, such as the polar regions. There can be no objection to robbing a land fit for no better fate.

Gold exercises an influence on the imagination which can only be characterised as magical, for it is not reasonable. The physical toil of getting alluvial gold is perhaps heavier than any other, the prices of the necessities of life are higher on gold-fields than anywhere else, and more money seems to be wasted on drink or lost in gambling in the intervals of mining than in any other conditions. The fact that gold is the common standard of value probably accounts for the illusion that gold-fields are better worth travelling to and working on than coal-fields or brick-fields. If the reader takes the trouble to divide the annual output of the gold-fields of the world as officially declared, with the official number of miners engaged upon these fields, he will find that the output per man often does not exceed £1 per week, and very rarely exceeds £2. Wages on these gold-fields usually run from £3 to £5 a week at the cheapest, and there is the cost of machinery and interest on capital looming large behind. There is certainly something wrong, perhaps with the statistics, but perhaps in the idea that gold-getting is usually profitable. That some gold mines pay high dividends, then, only makes it more mysterious how the others continue to exist. It has been suggested that taken over all gold-mining never pays, that more than £1 has to be expended in order to extract gold enough to make a sovereign, and that this fact explains why gold maintains its value nearly unaltered in spite of the enormous increase in its production. I do not profess to understand, and do not wish to press this argument, but mention it parenthetically as a thing to think about.

In speaking of the development of a self-sufficing country we introduce a condition which can be satisfied only by a country which covers half a continent like the United States, or a whole one like Australia. But when the high state of efficiency of means of transport, especially by sea, is taken into account, even the British empire, scattered over all the world, may be considered as one country which might certainly be self-sufficing. The possible extension of the principle of federation or economic union even raises the thought—visionary enough just now—

that the only self-sufficing "country" to be ultimately dealt with is the whole land-surface of the planet. Most of the countries of the world are only endowed by Nature with a portion of the commodities which civilised life demands as necessities or refinement requires as luxuries; hence for most countries trade is as imperative as production, and the question as to the symmetrical development of the existing resources is beset with additional difficulties. One may inquire whether it is necessary to work any of the resources of a country except the most profitable, buying the other commodities where they can be had cheapest.

For many years the agriculture of the United Kingdom has been allowed to decline, while food has been bought from other countries with the money paid for the products of British mines and factories. This is a natural consequence of the specialisation of modern life, but there is an underlying condition which often seems to have been lost sight of; from which, indeed, it is more comfortable to avert the mind.

Let us look at the case on different scales of magnitude. When the cabbages in Smith's garden are a failure, and the potatoes in Brown's are diseased, the exchange by which Mrs. Brown gets good potatoes and Mrs. Smith good cabbages is a mere matter of domestic economy. When the fire-engine of Ingleglow is lent to save Rodesworth village inn, and the Rodesworth steam-roller is sent in return to improve the ways of Ingleglow, the interchange becomes a parochial affair. A few more rings of the widening wave bring the interchange of coals and manufactures for food and raw materials into contact with international politics. Here geographical considerations which were unnoticeable in the transaction of handing a basket over the garden fence, and not very important in passing from village to village, become clearly recognisable. As long as amicable relations last there is no reason why each district, however small or large, should not produce only the products which suit it best, and trust to trade to supply all the rest; but when dissensions set in Mrs. Brown will run the risk of having no potatoes, and the whole village of Rodesworth may perish in flame, while the manufacturing and mining country may be starved into subservience by a jealous rival. The myth that lapse of time and growth in civilisation make war impossible prevailed at the millennium of Christianity in 1000 A.D.; it was accepted as a demonstrated truth at the first international exhibition in 1851, and the Peace Conference of 1899 may have been taken seriously by some people at the time. Events have shown in every case that war is an eventuality which can never be disregarded; and the usages of international law are not to trust to in a struggle of the life and death of nations.

Apart from such human and theoretically preventible difficulties there are natural accidents to beware of. Transport may be interrupted by storm, the staple crop may be destroyed by disease, and then the district of one resource must suffer acutely, while that in which several resources have been developed proportionately may escape with only some temporary hardship. The old sugar-growing countries furnish a perfect example of the first case, Ceylon of the second. These considerations show that the development of every separately organised portion

of habitable land—be it country or colony or island—should be made as complete and all-round as possible, while maintaining the natural advantages given it by the predominance of any one resource. The staple should be the chief, but never the exclusive, production.

The strictly scientific point of view looks to the final results of courses of action, but the commercial point of view must take account of temporary conditions, such as fluctuations in prices, which may ruin one country and raise another to prosperity, without affecting the general balance of the world. The individual is of necessity at the mercy of financial considerations. When the price of copper falls he must shut up his copper-mines; when the price of wheat goes down too low he must grow something else. When, after a time, the prices revive, the miners have gone elsewhere, the works are filled with water, and their restoration is so costly that they may be permanently abandoned; but the wheat crops can be brought back to the field in a year's time. In such conditions it is a question whether the individual should not be supported by the community until the stress in his particular department is over. The Government of a country is bound to take steps to minimise the effects of natural accidents so as to avoid evil results to the country, and no finer instance of such a responsibility being assumed could be found than the treatment of famines by the Government of India. Great commercial disasters, too, have been recognised as occasions justifying public support; the principle is perhaps important enough to be more definitely accepted as a preventive, as well as a palliative, measure.

If the ultimate question is to be how to find room for the inhabitants of the Earth, it would seem right that the main resource of a new land should not be allowed to be worked in such a way as to make impossible the subsequent development of minor resources essential to its habitableness. For instance, if enormous masses of a sulphur ore of copper, or even of gold, underlie a wooded and cultivable country, would it not be wrong to work that ore to such an extent and in such a manner as to destroy the woods, sterilise the soil, and leave the place a desert when the ore is exhausted? On the other hand, it would be foolish to prohibit mining in an agricultural country in order not to reduce the ground available for crops; for where corn-land may bear a population of ten per square mile, and supply a large export trade, the mines might enable a population ten or twenty times as dense to find a comfortable living, and form a market on the spot for all the agricultural produce. So far as we can see the age of parochial exclusiveness is past, and that of cosmopolitan equality has not arrived, and the standard by which the development of a region has to be judged at the present day is that of a national policy. Nothing should be permitted in the way of utilising resources which in enriching the individual impoverishes or endangers the interests of the whole community, that is, of the country.

The study of the gradual growth of any of the old countries of Europe shows that geographical conditions, often unrecognised, directed the relation of the people to the land. It is possible to make too much of these conditions, which are only in rare cases sufficiently powerful to override all other considerations, and actually to dictate the order of

development; but it is more common to make too little of them. The most powerful of all geographical conditions, the fundamentally geographical condition, is the relief of the land. This brings to the surface or buries beyond reach mineral wealth, acts directly upon climate, conspires with climate to influence the nature and distribution of native plants and animals, and all together form an environment which moulds and directs the growth of human communities.

To take a familiar instance: the people of the mountains differ essentially in their manner of life from the people of the plains. Small communities grow up in separate mountain-valleys practically under the same natural conditions, but shut off one from another and left to develop independently. The hunters and crofters of each group of valleys naturally organise themselves into separate clans, at enmity or allied with each other as the case may be, and very similar in organisation all over the world, whether in the Highlands of Scotland, the Caucasus, or the Himalaya. All are at one in viewing the property of the plain-dwellers as lawful spoil, and raiding as a natural calling. Later, such clans naturally tend to confederate while retaining complete local autonomy, as in Switzerland, unless compelled by external forces to assume other forms. On the plains small communities could not keep wholly apart, unless separated by forests or marshes, and thus the agriculturists of a fertile plain tend to coalesce into larger political units, and to give rise to countries of great size, reaching from the sea to the mountains, or to some great river. They have few natural strongholds to help them to become a law to themselves, and so in mutual self-defence they come to live at peace with each other, and exchange the valour of the warrior for productive industry and trade.

The influence of land-forms is indirect as well as direct, acting even more powerfully through the control of climate than through the mere physical bar to intercommunication. The wet seaward slopes of a country in the temperate zone naturally become better adapted for green crops than for grain, which in turn flourishes on the more sheltered land of moderate rainfall. Again, the dry climate of the heart of a continent, or in the lee of a great mountain range, is as a rule only available for grazing and favourable to a nomadic life. Thus the native peoples who have grown up in different stages of culture on the great plains of North America, the Puszta of Hungary, the Steppes of Russia, or the semi-deserts of Mongolia, are curiously alike in their manner of living and in the elements of their social organisation.

It is chiefly, however, in their influence on the sites of settlements, and the lines of communications, that geographical conditions have shaped the old countries of the world, acting continuously and gently on countless generations of different race, and, in spite of the apparently revolutionary changes due to conquests by alien peoples, these causes have as a rule continued to hold the old villages and the old highroads to their ancient sites and tracks. The town grew up round the rock which gave a defensive position to the stronghold of the protecting baron, or it clustered on the level shelf of a raised beach or river terrace round a deep and sheltered inlet of the sea, or at the highest point up-stream

which the ships of the period could reach, or it grew beside the ford where prudent travellers arriving at nightfall wished to stay when the river ran high before risking a crossing, or at the mouth of a valley which led up to a high pass, or in the middle of a gap across a narrow range, or perhaps on a strip of water-bearing rocks where wells could be readily sunk for domestic supply; or the site might be fixed by the occurrence of valuable minerals or perhaps by water-power. This natural law of selection as applied to sites for settlements accounts for the fact that even in England to-day, though the average density of population exceeds 500 per square mile, there are large tracts where one may travel on foot for hours without seeing a house, and where villages are nearly a day's journey apart. And there are places where the villages are strung together on some narrow belt of a particular geological formation—such as the Upper Greensand in the Weald—like beads on a necklace, or where the whole surface of some outcrop—say of the Coal-measures—is covered with town joined to town as with a carpet.

Roads arose either from the widening of footpaths skirting the fields from village to village, or they were constructed to join distant points of particular importance, running straight across the open plain, or clinging to the bare ridges of the Downs so as to avoid the woods and marshes of the low ground, or winding through the gorges of a river valley to cross a stretch of broken country, or climbing by laborious zig-zags up the side of some wall-like range. The trunk-roads of a country usually follow the great structural lines of the land, either the thalwegs or the watersheds. Upon the trunk-roads settlements spring up where travellers find it convenient to halt, or the people of adjoining hamlets to meet for trade. The chief street of such towns is formed of the road itself, the High Street, and so the roads built to connect great cities are themselves the cause of the growth of smaller towns.

When railways began to take the place of roads their tracks were less dependent on local conditions. The hill which the road had to turn or cross was tunnelled by the railway; but in old countries the railways have to serve towns which the roads had created, so the main lines of the two systems are rarely dissimilar, though their track is more direct and their gradients easier. The sterner features of regional relief control railways like any other means of communication. In rough country the rails jostle the old road and the older river through narrow valleys, or wind along the sinuosities of the coast-line, or skirt rugged hill-slopes in search of an easy crossing.

In an old country everything has grown gradually, each new thing has been grafted upon that which it was about to supersede. In domestic lighting, for instance, the candle gave place to the oil-lamp, and oil to gas, and gas is yielding to electric light, each new advance being hampered and often rendered nearly useless by restrictions arising from the old. The amount of capital locked up in the results of the past prevents the free adoption of the advances of the present. Vested interests form one of the strongest barriers to the development of an old country. It is evident that new countries can and must be developed on different lines from those which led to the slow advance of

the old. The trail of the first few pioneers must be followed by the railway, and the road may often be omitted. The candle is followed directly by a complete installation of the electric light; the first rough wagon to jolt along the half-made streets of a new town is followed by an electric railway. The latest machinery is introduced at once in agriculture and in every budding industry, so that a single year may see a larger population established and a firmer hold taken of the land than a century would have seen under the conditions of a thousand years ago. One is tempted to believe that these great advances in invention and application have overleaped, and may ignore the barriers which controlled the old wayfarers and handworkers. This is not the case however. The primary control exercised by land-forms, and the secondary control by climate, are there just as they always were, although their action is to be measured by the standard of cost rather than by that of possibility. A town can be founded and a railway can be built anywhere, if sufficient money is available for the purpose; but the town will not be prosperous and the railway will not pay unless the site of the one and the route of the other have been chosen with reference to geographical conditions. When the British Isles were colonised a knowledge of the principles of geography was unimportant, for events moved so slowly that the slight differences of the resistances opposed to progress afforded sufficient guidance; and when a mistake was made, the result affected only a small district and a few people, and was easily retrieved. Now things are done so rapidly and on so large a scale that a mistake involves very serious consequences and may affect a vast number of people. The failure to dig a canal in Saxon England was never very far-reaching in its effects; but the failure of the Panama Canal Company was one of the great catastrophes of the world. Such mistakes can be avoided by studying the natural conditions which will come into play, and, as a rule, engineers recognise this, and found their plans accordingly.

The blunders made by statesmen in attempting to draw international boundary lines so as to be capable of demarcation and to secure a fair division of natural advantages have been frequently held up by the geographers of all nations as terrible examples of the workings of geographical ignorance. A definite, practical, and easily demarcated boundary is absolutely essential to the tranquil development of a country with neighbours. Such a deplorable muddle as the boundary of Alaska, and such futile suggestions as those which were made for the boundaries of British Guiana, could never have been if the statesmen who were responsible had consulted geographers and had acted on their advice. But within a securely marked boundary the necessity of following a scientific method of development is equally urgent. While the blunders of governments have been held up to the light, it is pleasant to be able to refer to many acts of far-sighted policy, such as the magnificent survey of India, the charting of the coasts of the world by the British navy, the censuses of the United States, and the geological surveys of almost all British colonies and American states. Still, these measures are not always as well supported as they are planned.

We may suppose a great new country just appropriated by a

civilised Power, and about to be opened for exploitation, and try to indicate the manner in which geographical principles and past experience seem to require that such a country should be developed. There should be at the outset a central government of educated men with no personal pecuniary interest to serve. If it is decided to develop the land by means of great commercial companies, such companies should be strictly confined to their own work. Data for computing the risk of putting a company in possession of great political and territorial powers, and the expense of buying them back, may be found in the history of India, Canada, and South Africa.

It is the duty of a government to know its country. Surveys are of the very first importance, and it would be a good investment to make these thorough. A trigonometrical network should be laid down first, with the smallest number of triangles of the greatest size possible to cover the country and fix the exact position of important points on the coast and in the interior. The large triangles form a framework on which to base secondary triangulations and fill in the detailed survey. The detailed survey should be topographical and aim at providing a map of the country on the scale of at least 1 : 50,000, or say the familiar and slightly smaller scale of one inch to the mile. Lines of levels should be run so as to enable the important features of vertical relief to be shown accurately by contours. The work with modern photographic methods should progress very rapidly in a country where there are only natural features to map, and no roads, buildings, or bewildering parish or county boundaries to be hunted for and laid down. The expense would necessarily be heavy, but not so heavy for a large survey as for a small war, and a timely survey may be the means of averting or greatly shortening a campaign. If the survey of British South Africa had been begun in 1820, or 1840, or 1860, or even 1880, and pushed forward with the ample supply of trained men the British Ordnance Survey could have produced, a war within its borders would be simpler, safer, and immensely cheaper in 1900. Such work in developing a country might with justice be made a charge on posterity by the creation of a national debt.

The survey when completed should be made the basis of all land transfers, as in Australia; the large scale necessary for cadastral maps in old countries is not required when the parcels of land are large and divided by straight lines at right angles, as in the American township plans. When small plots have to be transferred, a special survey of a small square on the land map could be made and registered without more expense than the routine legal formalities demand in old countries. The boundary lines of the subdivision of a country (*e.g.* into provinces and counties) should as a rule be meridians and parallels, or at least lines staked out to represent these, for it would be monstrous to have to shift boundary lines by a few yards if a more accurate determination of longitude showed that they were not quite in the intended position. In certain cases where there are natural boundaries such as a lake shore, a wide river, or a definite mountain range, the larger boundaries might advantageously follow these.

As each sheet of the topographical map is completed, the area it represents should be surveyed for its geological features, and the geological map produced with the least possible delay. In subdividing land into provinces designed to be ultimately units of local administration it may be well, if the relief of the land does not demand a different course, to draw the boundary lines at right angles to the prevailing line of strike of the strata, or to the coast line, so that each province will share the full variety of the natural resources. This was done by natural selection in many places in the old world. For instance, the communes surrounding some of the Hungarian lakes are divided by boundaries radiating from the water's edge, each commune having an equal share of the coast line and widening inland. So also in part of the Weald district the parishes are long and narrow, crossing the strike of the strata at right angles, and securing to each a strip of sheep pasture on the Chalk Downs, a strip of dry but water-bearing rock suited for a village-site on the Upper Greensand, a strip of stiff arable land on the Gault, and a strip of rough cattle-pasture on the Lower Greensand, where the river runs with its water carriage and water power. Such an arrangement adopted in a new country, when the geological features favoured it, would help to secure a uniform distribution of population, with every kind of occupation represented in each unit, and prevent the high specialisation and one-sided interests of a population exclusively mining, exclusively agricultural, or exclusively industrial. In order to lay out boundaries with reference to these features, it is necessary that at least a preliminary geological survey be made before settlement on a large scale is encouraged, so that the population which is introduced may be of the kind likely to benefit most by the resources and to develop the country in the most advantageous way. The practical value of a geological survey with regard to mineral resources is understood and acted upon in all countries; but it is rare to find such surveys carried out with the good equipment they deserve.

No less important is a hydrographical survey of the coasts. All dangers to navigation should be sought for and discovered without the intervention of the shipwrecks which have charted the coasts of the old world. The natural harbours should be sought out and their relation to the land lines of communication studied so that expensive artificial harbours may not be built in ignorance of the existence of a better haven. The best sites for lighthouses also should be fixed and marked with beacons to be superseded by proper lights when the increase of trade demands it. The hydrographic survey should not stop at the coast. The streams and lakes also deserve to be surveyed, and accurate data obtained not only of the navigability of every river, but of the volume of its water at different seasons, the slope of its bed, the rapids or waterfalls with the available horse-power of their energy. The government of Finland has made such a survey and issued a map which is of high importance in a country without coal. The exact relation of the level of the river-bed to the surrounding country becomes vitally important in the deltaic lands near the mouth where floods are often to be feared and have to be guarded against by extensive works, and also in arid or

semi-arid regions where the possibility of irrigation may be the touchstone of prosperity.

A climatological survey is another important desideratum, which has hitherto been much neglected even in well-peopled lands. It is not enough to equip a number of stations with instruments for observing temperature, rainfall, pressure, wind, and sunshine. The stations must be frequently inspected, and the observers kept up to the minimum standard of efficiency, and the stations must be placed in carefully selected positions so as to take account of the different local climates of a country. Good observations have to be collected for at least ten years, and often much longer, before any values which can be trusted to show the average climatic conditions can be secured; and once these are obtained the necessity for maintaining the meteorological service is not diminished, but increased. It becomes more easy every year for the central office to forecast the approach of changes of weather; and once the habitual storm-tracks of a country have been discovered, the establishment of a few additional stations in the places thus suggested may be the means of greatly improving forecasts and adding to the security and prosperity not only of fishermen and seafarers, but of farmers and miners. How important an extensive system of rain measurements is in some new countries appears strikingly in the common Australian calculation of converting inches of rain into number of sheep or even pounds of wool per acre. The part which the configuration of the land or its degree of cultivation plays in influencing local climate has never yet been fully discussed for any country, although such attempts in that direction as have been made on a small scale show that the subject is a promising one to pursue.

Further, a biological survey may be undertaken. The distribution of forests, and the nature of the trees composing them, ought to be accurately ascertained. Much of the prosperity of a country depends on the maintenance of a proper proportion of the surface under wood; and an enlightened system of forestry will tend not only to keep the supply of timber continuous, but to maintain the regular flow of rivers, and thus the fertility of the cleared land. In selecting lands for clearing in countries covered with natural forest care should be taken to distinguish between the areas which will yield good agricultural land and those which are fit for forest trees and nothing else. The kinds and habits of fish and land fauna should be studied by the government of a new land in time to prevent the extinction of useful species, and the introduction of species that might prove hurtful.

It is not necessary that the various surveys mentioned above should each have a separate and costly organisation. One field-party, selected so as to contain a few specialists and several general assistants, could attend to all departments of the land surveys. The main thing to secure is official recognition and adequate provision for such work, which is indeed often permitted as a sort of concession to the non-professional hobbies of surveyors.

Next to the stock-taking of national resources, the development of a country demands the provision of a serviceable system of communications.

To plan such a system requires the solution of a difficult problem in practical geography involving the foresight of probable town-sites and centres of population. The main lines of communication are usually supplied by the river-systems, either as lines of navigation or channels for roads and railways. In a temperate country it is natural to find convergent lines of communication closing in at the head of sea-navigation on a great river. Such lines, whether for water or land carriage, require to be completed artificially across the watersheds linking the various river-basins landward, and a final line to join together the towns which will arise along the coast would complete an ideal outline. As time goes on the great arterial lines of communication would be inter-connected at numerous points according to the exigencies of trade; but while the initiative and support of a government are necessary for the great trunk-lines of the framework, the subsequent completion may safely be left to private initiative. River valleys are not the only natural lines of communication. In some types of country the watersheds offer superior advantages for roads, as, for instance, in New South Wales; or some peculiar geological formation, like the great line of eskers parallel to the south coast of Finland, may compel both road and railway to occupy a ready-made track.

The advisability of considering general principles in planning a system of communications for a given region is sometimes prettily demonstrated by the absurd schemes which are put forward for railways to reach any place which comes temporarily into prominence. It is shown also by the frequent construction of two railway lines in a district which could quite well be served by one.

All navigable inland waters should be brought into connection with the general system of communications of a country as early as possible, for a light-draught steamer plying on a river becomes a good pioneer of a railway line. The placing of stations along a new line of railway should be regulated by regard to the natural converging points for roads, even if roads do not yet exist; attention has also to be paid, of course, to the proximity of supplies of water or fuel. The device of running the main trunk-roads in a system of rectangles is contrary to nature, and apt to result in unhappy gradients even in easy country. The main roads should run in harmony with the natural lines of the country-side, a mile or so of increased distance being balanced by easy gradients; but there is no reason why a rectangular system of bye-roads to connect adjacent settlements should not be associated with natural high-roads.

Every type of land-surface requires its special system of road location. As a general rule, the less engineering that is necessary, the more commodiously will the road perform its function of opening up a country. But, of course, exceptional cases demand exceptional treatment. On a dry level plain the roads may run straight from point to point; over a rugged mountain region which is only a barrier, it is often a question of relative cost alone whether a line will cross through a tunnel or wind over a pass; but as a rule the lie of the land should determine the line to be adopted.

In a new country the sites of towns are usually determined by the

positions of the most convenient harbours, the junctions of lines of communications, and the neighbourhood of extensive mineral resources. In the course of natural development the village or the town comes before the province, which is rarely a natural growth. But in many new lands the provincial boundaries are first drawn, and a centre of administration has to be placed somewhere within the area. It is by no means necessary to have this centre in the middle of the province; in fact, nothing is more striking on the political map of any continent than the non-central position of the capital of almost every country—Madrid is the only conspicuous exception.

The practice of planning out towns in rapidly growing countries on one common chessboard pattern has many points in its favour. It is simple, allows of easy registration of building lots, and a stranger can always find his way about. The plan, however, is only adapted for level or slightly undulating sites. A town ought to be planned and built for a site as carefully as a suit of clothes is measured and made for a man. A rectangular plan for a triangular site at the junction of two rivers, or in an amphitheatre of hills rising from a bay, or in a narrow mountain valley, is a misfit, and can never be either comfortable or convenient. It stands to reason that on a broken site one set of streets should run nearly in the curves of contour-lines, keeping almost to one level, with just slope enough for ready drainage, while the connecting streets descend the slopes not at right angles, but obliquely to reduce the gradients. Planned thus, a town acquires distinctive character from its site, and avoids the shame of rectangularly intersecting streets, each horizontally straight, but undulated like a switchback railway, or perhaps with its row of houses broken here by a bridge over a gorge, there by a face of rock in a deep cutting. In selecting the site for a new town the questions of drainage, water-supply, and security from risks of flood or landslips have all to be taken into account. From the neglect of one or other of these precautions new towns have time after time been failures. The familiar unhealthiness of new goldfields is usually due to the complete neglect to provide any system either of drainage or of water-supply, and these are only acute instances of a chronic defect in the growing towns even of the most progressive colonies. The question of sewage disposal is quite as urgent a problem in a new community as in an old one; and there is the less excuse for neglect where one can start from the beginning with the experience bought by more deaths than have occurred in all the battles of all ages.

The last and most important element in the development of new lands is the introduction of the right sort of people to inhabit them. The chief difference between a new land and an old is the more primitive character of the former, and thus one might be tempted to suppose that the best type of inhabitants would be those who care least for the comforts of life, and are least dependent on elaborate methods of working. But in a new country, where labour is scarce and dear, every labour-saving contrivance must be used, and the best machinery is worth obtaining, so that adaptability to new conditions and intelligence to make the utmost use of the latest advances count for much. The farmer

who at home still looks upon steam machinery as "new-fangled" may find himself confronted in Australia by sheep-shearing machinery run by electric power. At the present day it would be hard to find in any developing colony the four-armed windmill against which Don Quixote fought, but modern wind-motors on their lofty steel shafts are common. New lands must be developed by modern methods, and the best type of man who can be found is not too good for the work. The desirable qualifications are to be strong, practical, educated, and open-minded.

From the point of view of government the new lands of the temperate world are almost equally divided between, on the one hand, the autocracy of Russia as exercised in Siberia (which contains more than half of the new lands comfortably habitable by Europeans), and on the other the republican governments of the United States and South America, and the no less liberal forms of self-government followed in the British colonies of Canada, Australia, and South Africa. The new lands of the second category have become refuges for people subject to political or religious disabilities at home, and so are gathering in amongst a prevailing Anglo-Saxon population a mixture representing almost every European race. There can be no doubt that new racial types are now developing in the environment of the new countries by the grafting of branches of every variety of the white type of mankind into the prevailing Anglo-Saxon stock. It is a healthy sign that in almost all new countries efforts are made to prevent the intrusion of undesirable immigrants, while those who are suitable are welcomed regardless of race or creed.

While the future of the new lands now undergoing development is more in the hands of the people who are carrying on the work than was ever the case before, the necessity of state guidance and help at the outset was never greater. The whole community recognises the necessity of a complete system of communications, of holding and administering the vacant lands as the property of the state until required for allotment, of keeping order in thinly settled districts and amongst the shifting crowds of mining camps, of assisting and encouraging agriculture, and generally aiding in the development of the country by an expenditure of capital which could in no other way be obtained without the establishment of monopolies that would hamper the free enterprise of individual settlers.

Of all the methods by which governments assist in developing new countries, the most important is perhaps the promotion of irrigation works. It is believed, although the evidence on the subject is perhaps not yet conclusive, that a gradual process of desiccation is going on in all the continents, diminution of rainfall and increase of evaporation leading to the extension of deserts and the sterilising of steppes. The fact at least is certain that in every continent there is a vast area of arid or sub-arid land, the rainfall on which is insufficient for any form of agriculture, or even of good pasture. The great plains which stretch along the east of the Rocky Mountains from the borders of the sub-arctic forest to the Gulf of Mexico, the pampas of Patagonia, the high veldt in South Africa, the whole interior of temperate Asia, and almost the whole continent of Australia require only a water supply to become permanently

productive lands. The works required for irrigation on a large scale are too costly, and involve the treatment of too great an area of country to be undertaken profitably by individuals or even associations. They require geographical changes of the first order: the construction of reservoirs as large as lakes, the diversion of rivers where they flow full and perennial from the mountains, so that instead of reaching the deep-sunk beds which literally *drain* the country, they are made to flow at the level of the general surface, above the valleys towards which the water must be trained to flow through irrigation channels which vivify the land. Already governments have begun to bestir themselves in this direction, and the irrigation surveys of the United States are a fine example of what can be done. But every land surface has its own intimate character, the treatment of which must be, if one may so put it, personal to itself, and methods successful in one place may not prove to be equally applicable to another. This is indeed true of all efforts to develop land; imitation of work accomplished elsewhere is not enough, every region must be studied in itself before the appropriate treatment can be prescribed.

Many complications arise in the development of a country which require to be faced and dealt with. No land can be looked upon as absolutely "new"; some one has been there before, and some artificial disabilities have to be contended with in addition to those arising from nature. Amongst these the most serious arises from the presence of aboriginal inhabitants of a low grade of culture. Such primitive peoples are dangerous in many ways. They may resent the settlement of their hunting-grounds and make reprisals on settlers for the loss of their game, as in Australia; they may cause the deterioration of the superior race by intermarriage, as in South America; or, without going to either extreme, they may lead to constant irritation and slow degradation among the settlers on the outposts. It is rarely that native races make good workers. Sometimes by careful management small communities are trained to work in civilised methods and show great aptitude for special callings; for instance, the Indian pilots who steer the steamers through the rapids of the St. Lawrence. Frequently the contact of white and dark races results in the rapid extinction of the latter; but there are cases where the compulsory preservation of peace between native tribes leads to a rapid increase of the coloured population, as in Natal. The problem of the treatment of the subject races is very difficult. The spread of a knowledge of reading and writing, or the adoption of Christianity, does not necessarily fit the native for self-government; and however widely the political suffrages of a country where white and coloured races live together may be drawn, means are usually found to prevent the exercise of any real political power on the part of the latter. It is a question worth discussing whether a frank recognition by the administration of a state of matters which exists might not be a sounder policy than that of proclaiming equality before the law and allowing the proclamation to be nullified by the force of custom. There is no doubt that by wise treatment from the beginning native races might preserve their self-respect and be brought to occupy

a useful position in the growing life of a new country. But it is unfortunately rare to find a native race unhurt by premature contact with the scum of white society which floats over all the world in advance of the wave of worthy settlers; and the mischief once done is hard to repair. Again and again since the first great successes of the Jesuits in South America Christian missions have succeeded in bringing isolated native tribes into a state of industry and happiness, without loss of health or vitality; but if there are any cases of primitive peoples brought into a state of civilisation high enough to enable them to resist deterioration by contact with degraded whites, they must be very few.

The civilisation of the white race is the result of long development in conditions which have been gradually changing; and it is now being generally recognised as unreasonable to expect to bring races, inferior at the start, to a high plane of culture in a few generations. The development of new lands must be viewed from the point of view of the European conquest of the world; and it is mere affectation to pretend that native races, handicapped by an inheritance of intellectual and moral inferiority, can be placed at once or soon upon an equal platform with the white. That exceptions exist it is a pleasure to recognise, but the rule prevails. If it is necessary to impress on people at home the folly of treating prematurely and superficially civilised tribes as equals, it is unfortunately even more necessary to warn white settlers in distant lands of the wickedness of treating the aborigines as people without rights. The criminal brutality of white settlers with regard to natives is a scandal usually denied in print, but frankly enough acknowledged in conversation. It should be the business of every government to secure the right of all natives to undisturbed possession of a sufficiency of good land, and to see that the punishment of natives for crimes which they do not understand should be on a more lenient rather than on a heavier scale than the punishment of similarly-offending whites. It is not difficult to secure the passing of excellent laws on this subject, the difficulty lies in their application.

A problem of another kind arises in many cases from the conflicting interests of new immigrants in a country and the descendants of earlier settlers, perhaps of a different European race, who have grown into harmony with their new surroundings, but cling to old ideas which the newcomers have outgrown. It has recently been fashionable for newspapers, even those of the highest standing, to fan the ever ready flame of racial antipathy, and the blame for this can always, and usually justly, be thrown by either party on the other. In time, with a good deal of mutual forbearance, these dissensions die away, for the newcomers in their turn take the colour of the country and adopt the resultant mode of life. The accentuation of racial troubles may perhaps be usually referred to periods during which the rate of immigration is too rapid, and the newcomers have not had time to acquire that adaptation to their new conditions which would bring them into friendly touch with the earlier occupants. These too require time to recognise that they must allow new methods of development of the land which they have been accustomed to ignore or despise. Such dissensions, painful and disastrous

as they sometimes may be, are mere episodes in the process of adjustment to environment which is always going on, and always tending to a condition of ultimate equilibrium. The rebellion on the Red River in Canada in 1870 may be traced to this cause, and it has led to the result indicated by general principles. The applicability of a similar line of argument to the present position in South Africa need not be insisted upon.

Settlers in a new land become, at any rate in the second generation, creatures of that land; and although they may maintain the most cordial and loyal relations with the country of their origin, they are bound primarily to their adopted soil. No land can be fairly developed by people who merely wish to snatch a fortune or a competence from it, and go elsewhere to spend it. This is perhaps one secret of the failure of chartered companies in their political character. It is impossible to transport a nation to a new land; the result of anthropogeographical study is to show that in a new land a new nation is developed, the power and influence of which in the world's history does not depend upon maintaining old nationality, though it depends largely on retaining old sympathies. Who can say that New France has lost in any degree in becoming Canadian; or that New England is less influential since it became American? The grip of the land on its inhabitant is a thing of nature, the source and safeguard of patriotic feeling. Just as the loyalty of a Scotsman is fervent to his narrower fatherland, yet unquestioned to the kingdom and the empire; so through the devotion of the people to their land which grows with time, and not quickly, a real yet a diverse patriotism is arising in every associated unity of the British empire which will hold it together in virtue of the common sympathy until in some distant age it enters as a majestic unit into the wider "Federation of the World."

MILITARY GEOGRAPHY: A REVIEW.¹

It has been not inaptly said that "Geography is the science of conquerors." This general statement may be taken to include two interdependent propositions. The opening up of countries by invading hosts has enabled us to acquire a knowledge of their configuration, of their population, of their resources; but at the same time an antecedent accurate knowledge of the area involved is absolutely indispensable in order to the successful issue of military operations. With both of these propositions we are here intimately concerned. For what is military geography? Nothing less than geography as it affects military operations; geography as it interests, as it should be studied by, military men. Military geography, then, must, if it is to be studied with profit, if it is to inquire into the "wherefore" of things, and not simply content itself with an account of things as they stand, rest on a sure foundation. It

¹ *Outlines of Military Geography*, by T. Miller Maguire, LL.D., Cambridge, 1899. (Cambridge Geographical Series.)