

THE FUNCTIONS OF MOUNTAIN SETTLEMENTS IN RELATION TO
THEIR PHYSICAL ENVIRONMENT

RUTH HANNAM

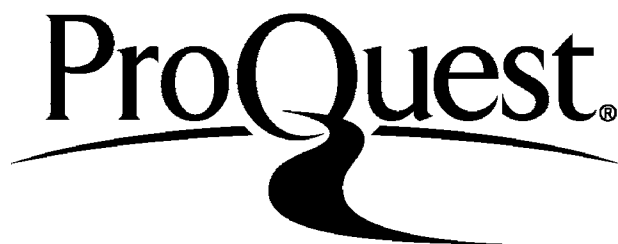
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ABSTRACT OF DISSERTATION

THE FUNCTIONS OF MOUNTAIN SETTLEMENTS IN RELATION TO THEIR PHYSICAL ENVIRONMENT

A settlement is an expression of man's activity, therefore they can be classed according to the predominant activity in a particular place. The effect of mountain conditions on the choice of site and the mode of living in different types of settlements is discussed.

I. Agricultural and Pastoral Settlements.

These are the most numerous; the effects of altitude, exposure, degree of slope, the nature of soils and land forms, water supply and type of farming are discussed. Examples (personal knowledge). Reichenbach (Kander Valley) and Devoluy in the Alps, Pyrenean Navarre and the Pic de Europa in Spain.

Others. The Val d'Anniviers; the Hunza Valley in the Karakoram; the Altiplano of Bolivia.

II. Mining and Other Industrial Settlement.

Mining in relation to geology and structure; artificial character of mining towns; areas where they are most important. Small manufacturing industries. Hydro-electric power development.

Examples (personal knowledge). Jenbach (Austria); Welsh slate quarrying.

Others. Silver Peak and Blair (Nevada); Black Hills of Dakota; Styria; Harz Mts.; hydro-electric power in the French Alps.

III. TRADING SETTLEMENTS

Relationship to routes, especially to passes and mountain valleys. Mountain border towns; transit trade; local market towns. Some characteristics of mountain trade on different continents.

Examples (personal knowledge). Innsbruck, Thun.

Others. Grenoble; Nepal Himalaya.

IV. Strategic Sites.

Defensible sites; relation to physical features. Common points with trading settlements. Relationship changes in systems of communications, methods of war and positions of frontiers.

Examples(personal knowledge). Briancon(Alps); Ronces and Burguete(Pyrenees).

Others. Trento, Sion.

V. Health and Holiday Resorts.

Recent growth; advantages of climate; scenery. Development of tourism in mountains accessible to large centres of population with a high standard of living. Hill stations in Monsoon Asia.

Examples(personal knowledge). Grindelwald and Bardone in the Alps. Sierra de Guádarrama in Spain.

Others. Canadian Rockies.

VI. Conclusion.

Relation to historical changes. Depopulation of mountain areas, its causes and effects. Possible industrial developments. The uncertainties of a frontier region (Julia). Continuance of change.

Ruth Hansam

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INTRODUCTION.

This study is an attempt to co-ordinate the characteristics of certain settlements in mountain areas and as a result, to present them classified under certain headings. To start with, some definitions are necessary, for example, what is to be included as mountain settlement? A limit of absolute altitude cannot be taken, for while in high latitudes even a slight increase in height above sea-level has a marked effect, in the tropics a much greater height may be attained before there is a significant differentiation in type of economy and settlement. What has been included has been judged on this basis; if there had been lowland in the same position would settlement have developed in the same form that it now reveals? Mountain landforms, steep slopes, climatic differences resulting from altitude and the associated differences in vegetation, these are factors which, if operative, justify the inclusion of the area.

Jean Brunhes, in discussing the classification of the facts of human geography, says of Ratzel, 'He saw human groups and human societies developing, always within certain natural limits, always occupying a certain place on the globe, and needing always, in order to nourish themselves, to subsist, to grow, a certain space This activity finds expression in 'visible and tangible' works, in roads and canals, in houses and cities, in clearings and cultivated fields. There is everywhere evidence of man He observed men seeking their livelihood.' (1) To take up the last words of this quotation, men seeking their livelihood in the mountains have occupied certain places where it was possible to carry on their work. A village, a town, a city, is primarily a community of men working; while within one such community there will certainly be found a variety of occupations, usually there is some one activity that is particularly characteristic of that settlement. So one may with justification speak of an agricultural community, a commercial city, a mining town, an administrative centre. These are the expressions of the functions of those settlements; they are the visible signs of man's activities. It is on this basis that settlements are classified in the following account, with regard to the special circumstances obtaining in mountain lands.

(1) J. Brunhes. Human Geography. New York, 1922. P.32.

They are grouped as follows;

1. Agricultural and pastoral settlements.
2. Mining and other industrial settlements.
3. Trading settlements.
4. Strategic sites.
5. Health and holiday resorts.

This classification has been worked out to draw together observations made during a number of visits to mountain areas. These were mainly concerned with the predominant type of occupation of the people and with the site and physical environment of the settlements. The consideration of the places visited, and their comparison with each other and with examples from literary sources, led to the formulation of some conclusions as to the way in which the above functional types of settlements may be influenced by their location in a mountainous environment.

In presenting this study the following procedure has been adopted. First the chief physical, economic and other human factors affecting the establishment, growth and survival of each type of settlement has been surveyed in general, with some indication of the extent to which they occur in different parts of the world. This is followed by the more detailed description of a number of examples to illustrate the operation of the conditions previously discussed in general terms. Often the examples overlap two or more sections since a settlement of any size is likely to have more than one simple function. Since personal knowledge of the writer is confined to Europe literary sources have been used for examples from other continents, as they have for certain outstanding examples in Europe, e.g. the commercial city of Grenoble, the Val d'Annivers, industrial settlements in the French Alps.

To present such an account, based on a limited number of selected examples, is only to skim the surface, and in the execution it poses more questions than it answers, particularly in that primarily physical factors are dealt with, and not the multiple social and historical factors which are also involved in the character of a settlement. However in this wide field of possibilities the discussion has been limited to a survey of the effect of mountain landforms and climate on the siting of settlements with

reference to the basic occupations of the inhabitants.

In connection with the Spanish examples cited, I should like to acknowledge the kindness of Bedford College Council, which by awarding me the Dame Margaret Tuke Travel Bursary in 1951, made possible the visit during which the field work was done.

SECTION I

AGRICULTURAL AND PASTORAL SETTLEMENTS.

By far the largest number of settlements in mountains are agricultural and more space will therefore be devoted to this type than to any other. To say that such settlements are in the majority does not imply that conditions are favourable; in fact the opportunities are very sharply circumscribed. Factors of altitude, exposure and degree of slope are particularly important in highlands; the nature of the soil, access to markets and relations with neighbouring lowlands also play their part in influencing the number, type and position of settlements.

ALTITUDE.

The first point to be considered is the direct effect of altitude. This must be related to latitude, for whereas in the tropics altitude results in successive changes in type of farming and only in a limited zone excludes it, towards the Poles farming becomes impossible at relatively low altitudes. In Tibet and in the Andean Puna (cold semi-desert) in Bolivia villages are found a little above 15,000 feet; this is the limit of permanent human occupation. Some mining establishments in the Andes are over 16,000 feet, but here we are not concerned with them. In the mid-latitude regions, settlement in the Alps reaches 6,000 to 7,000 feet at the outside; polewards the limit falls ultimately to sea-level.

The limit is imposed, not by man's incapacity to live at great heights, but by lack of food. One example of the physiological adaptation of man to great heights is found on the Andean plateau, for instance in the Kicina and Aymara Indians, people of low stature with short limbs and large chests. Such people suffer if they are removed to low altitudes. This was recognised by the Incas of Peru; for example, if fighting at lower levels they completely replaced their army every few months to avoid deterioration, and they had a general rule of not sending men to markedly different levels. Polar and Everest expeditions show that man can exist in great cold and at great heights, but of course they do so in specialised conditions; generally speaking the limit is imposed by economic ^{factor} i.e. by the ability to live by local products. The extreme limits are Fleure's "regions of hunger" where a very little disturbance can upset the balance.

It is not, therefore, man's limitations so much as those of plants and animals which have to be considered. The most obvious one is the result of the reduction of the growing season by the decrease of temperature with altitude. In this connection it must be remembered that the degree of insolation at great heights increases considerably; above 4,000 feet the impurities in the atmosphere have diminished and there is less thickness of atmosphere above. Therefore though the air temperature may be low, the sun's rays are very powerful and the ultraviolet rays are particularly intense. This not only promotes the very rapid growth of pastures after the melting of the snow in spring but also improves the nutritive value of the plants. Such high-level pastures frequently play a very important part in the economy of mountain villages; communities use summer pastures several thousand feet higher than their permanent settlements, with temporary habitations at the higher level. For instance a village in the Alps at 5,000 feet may use pastures up to 7,000 or 8,000 feet; Tibetans go up to 18,000 feet with their herds of yaks. Thus transhumance extends the possibilities of settlement, because by using the alpine pastures the villages are able to use the land near the village for hay and fodder crops to feed their animals during the winter.

The ascending vegetation sequence on a mountain range is, generally speaking, comparable to the poleward sequence. The 'alpine' type nevertheless differs from the tundra type in richness of growth as a result of this intensity of insolation and better drainage, making the area of greater use for pasture. Also the vegetation belts are relatively narrow and the use of two different ones in opposing seasons is thereby facilitated. Alternatively the contrast in climate produced by contrast in height may make possible inverse transhumance; a mountain settlement which cannot provide for its flocks with hay or fodder crops during the winter may send them down to nearby plains for that season. Again, a settlement similarly placed may receive in summer flocks from the plains, as for example the Dauphiné Alps feed the flocks of the lowlands of Provence (see description of Devoluy below). In this way the factor of height, which created the difficulty of living on local products in the first place, helps to provide its own answer to the problem.

In Europe permanent settlement is rarely above forest and cultivation level, though a community with two seasonal villages may have one above the general cultivation level (see description of the Val d'Anniviers, p. 20). For example in the Val Pellice the whole population moves to the alpine village in early summer. This can hardly be called permanent settlement but is nearer to it than the case in which only shepherds live at the higher level during the summer months.

Examples of some high settlements in the Alps (2).

Juf (part of Cresta) (Grisons)	2133 m.
Cresta	1956 m.
Averole (Maurienne)	2035 m.
Arosa	1892 m.
St. Morits	1836 m.

(the last two are larger because of their tourist trade).

In the Andes on the other hand there are settlements in the pasture zone above the forest. Here in tropical latitudes there is cold semi-desert above 12,000 feet. Being above the zone of maximum precipitation, rainfall is low even where the exposure is favourable. The soil is lacking in humus and the plant cover is intermittent. In basins where there is better soil of glacial origin and water which has drained down from the snows of higher areas some cultivation is carried on, of potatoes and quinoa; animals (lamas and alpacas) are important. The highest habitations of the world lie at about 17,000 feet in the Maritime Cordellera of Peru, where streams fed from snow produce narrow ribbons of pasture almost to the snowline(3). This is the absolute limit of habitation; shelter from wind and driving snow in winter is at a premium here. Potatoes and barley for food must be brought from lower villages and only the poorest of shepherds live at this level. There are no villages, only occasional huts or groups of huts. The majority of the Andean population live on the plateaus, intermont basins and valleys from 6,000 to 11,000 feet, where the vegetation ranges from woodland to grassland with isolated trees and the temperate climate renders the region more favourable than the humid forests or deserts of the lowlands in the same latitudes. South of the Tropic of Capricorn this no longer holds good and as the climate of the high mountains becomes progressively more severe

(2) J. Blache. *L'Homme et la Montagne*. Paris, 1933. p.77.

(3) I. Bowman. *Types of 'Islands' of the High Mountains*, in Brunhes' *Human Geography*. New York, 1922. p.468 - 471

the limit of permanent settlement drops, reaching about 6,000 feet in southern Chile so that it is comparable with European areas in similar latitudes.

In the Western Cordillera of North America where natural conditions do not conspire to concentrate population on the highlands as in the inter-tropical Andean zone and where a larger proportion of the mountain area is forested, settlement is so far from saturation that its actual limits are far from being co-incident with the possible limits. Altitude influences the type of farming carried on in irrigated basins at considerable heights (between 4,800 and 6,000 feet) but it does not yet impose marked control of settlement.

In Asia with its greater general pressure of population and long history of settlement the mountain areas are well occupied. In Tibet much of the plateau which is 10,000 feet and higher has scanty grass which sustains yaks and sheep but agriculture is possible only in the most favoured parts. In the mountain ranges of Eastern Tibet there is abundant grazing and more agriculture is possible. Here villages and crops are found up to 13,000 feet and more; there are some fairly permanent shepherds' habitations at 16,000 feet; the village of Gartoy is at 15,000 feet. Barley is grown at 14,000 feet though not in every year, and wheat and vegetables at 11,800 feet. Apricots will grow to 13,000 feet but vines at not more than 10,000 feet (4). The Pamir region, a dissected plateau region even higher than Tibet, has very high glacial valleys ('pamirs') at a height of 12,000 to 14,000 feet. Filled with glacial deposits and fed by streams from the surrounding snowclad peaks and glaciers, they are fertile and offer abundant pasture, but their isolation and the icy blasts of winter discourage settlement and they are the home of only a few nomadic Khirgiz.

In the Himalayas exposure and degree of slope play a very important part and control by altitude is not so clearly distinguished. Leh in the upper Indus valley lies at 11,503 feet, and there are villages higher than this. A description of villages in the Hunza valley is given below (p. 34).

The African plateaus do not rise to anything like the altitude of the ones in South America which are comparable in latitude, so that only on individual mountains such as Mt. Kenya and Kilimanjaro do alpine conditions occur; high savanna and evergreen scrub are typical of the higher

(4) Blache op. cit. p.76.

parts of the plateaus. Height does not therefore set a limit to settlement. It does have a marked effect on the type of people in the settlements since the more temperate climate makes possible European settlement i.e. in Kenya. On the grasslands of the Uasin Gishu Plateau there are European farms at 8,000 to 9,000 feet, producing sheep, pyrethrum, flax, wheat and oats. On either side of them are pastoral tribes, the Nandi to the west, the Elgeyo to the east, in scattered homesteads, counting their wealth in cattle and despising the agriculturalists of lower levels. Below the Elgeyo Escarpment in the Rift Valley the Kamasia, part pastoralists, part crop farmers, live at 4,000 to 6,000 feet (5). The bulk of the African population of Negroes and Bantu is not so well adapted to great heights and their lower temperatures as are the Andean peoples so that they do not so readily take to the higher plateaus and mountains, which remain relatively empty.

These examples from different continents serve to illustrate the difference of the limits set by height in varying latitudes and how the question is wrapped up with the occurrence of zones of vegetation. Factors of exposure and degree of slope constantly creep in as soon as any particular area is considered; the special influences which they exercise will now be considered in their turn in order to qualify what has been said about the effect of height.

EXPOSURE.

With exposure as with altitude it is primarily its effect upon plant growth which is important. Exposure affects the amount of insolation received and the amount of precipitation. This is most clearly seen in the position of the snow-line and the existence or non-existence of glaciers. This does not merely indicate where the highest zone of vegetation, one quite uninhabitable, begins; in dry mountain regions it is a matter of the utmost importance because on it depends the possibility of irrigation. The amount of glaciation on each side of a mountain range depends mainly on the amount of precipitation. For example in the western Himalayas on the south side the snow-line is at 16,400 feet; on the north side at

(5) R.O. Hennings. African Morning. London, 1951. p.28, 171.

18,700 feet; this is because the southern slope is exposed to rain-bearing winds and may have as much as 150 inches of rainfall per year, whereas on the lee side the rainfall is negligible (Leh has 3" annually).

The point dealt with above is a general one affecting a whole mountain range; in more detailed consideration of the effect of exposure the amount of insolation received is the most important influence. This is best illustrated from the Alps where the realisation of its importance is shown by local terminology. The most simple relationship is observable in an east-west valley. The south-facing slope - the 'adret' - not only gets sun for more hours of the day but it is more effective because owing to the angle and direction of slope the sun's rays fall more vertically and insolation is correspondingly more intense. The most important effect of this intensity of insolation is that the soil is very considerably warmed. Generally speaking the greater the height the more effective this is and the difference between air and soil temperatures increases. The 'ubac' is at a corresponding disadvantage. The 'adret' will be covered with rich pastures and crops while the north-facing 'uhac' is usually forest-clad. Villages will likewise be sited on the 'adret' unless unsuitable topography precludes it and forces the use of sites on a less sunny but gentle 'ubac' slope. This contrast between the two sides of a valley is most clearly marked in a great longitudinal valley such as the Engadine. The higher the valley, the more marked is the concentration on the 'adret'.

In the north-south valleys the effect is less marked but may still be discernible. If there are spurs jutting out into the valley the effect will be observable on their two sides; to travel along the valley southwards will give an impression of little cultivation; to travel northwards will give an impression of much cultivation on the south-facing slopes of the spurs (see reference to this phenomenon in the account of the Picos de Europa given below).

When both the duration of sunlight and the intensity of insolation are taken into account the reasons for individual settlement sites may become apparent. Dr. A. Garnett has shown this in her studies to illustrate the cartographic technique by which these may be investigated. In her study of the Deferegenthal in Austria,

for instance, she shows how insolation values exert a selective influence on the distribution of cereal cultivation in the valley. Duration of light is important as well as the heat warming the soil. Every locality in the valley will have a different combination of circumstances influencing its land use and potentialities for settlement (6).

Though apparently the most sheltered part, the bottom of a valley is often climatically unfavourable, especially in a deep narrow valley because of the drainage of cold air down the slopes, particularly in anti-cyclonic conditions. This, combined with the greater insolation received, makes the 'adret' slope a better position for settlement.

A deep very sheltered valley may be very warm indeed in summer. An example of such a one is the Upper Rhone valley; the height of the valley floor is only 1,500 feet above sea-level and conditions near Sion and Sierre and other settlements are similar to those in south Italy. The resemblance is heightened by the semi-arid vegetation due to the hot dry air and low rainfall. The limit of cultivation is unusually high for mid-latitudes; vines can be grown to 4,000 feet and grain to 6,500 feet, with the aid of an elaborate and ancient irrigation system, for the valley is overlooked by glaciated ranges feeding perennial streams.

Another example of valleys particularly favoured by exposure occurs in Northern Spain where the Picos de Europa range shelters the upper Deva basin, the Liébana district which lies between that range and the main summits of the Cantabrian Mountains. By slope and position it is entirely mountainous but the bottom of the valley is about 1,000 feet (Potes, 1,050 feet). As a result there is a sharp contrast between this area and the Asturian side of the range; the latter is wet and green with pasture, hay and maize predominant; in the Liébana vines and many kinds of fruit are grown and the typical vegetation is of the maquis type; there are numerous villages. It belongs to the Mediterranean world whereas the Asturian side belongs to the Atlantic lands (see below, p.24 for further details of this area).

(6) Dr. A. Garnett. *Insolation and Relief*. Institute of British Geographers Publication No. 5. 1937.

Mountain areas have infinite variations in local climates and many valleys have characteristic local winds. The most important type of wind is the Föhn. The air heated and compressed as it descends the valley may raise the temperature as much as 40° F. in 24 hours and causes rapid melting of the snow in spring. It may therefore make a great deal of difference to a valley which experiences it frequently. There is a disadvantage; the excessive dryness of the air makes fire a serious danger where the local building material is wood. Sometimes local laws require fires to be put out when the Föhn blows.

DEGREE OF SLOPE.

✓ Sometimes the influence of both height and exposure is overruled by a third factor, the degree of slope. With some inconvenience settlements can be built on slopes of high angle if necessary; here again it is the relation to agricultural production which is important. While agriculture will obviously make use of the flatter land where practicable, very steep slopes are cultivated with the aid of terraces. Still steeper slopes are used for hay. On the steepest slopes little soil will accumulate, so they are doubly unfavourable. ✓

In combination with exposure a considerable angle of slope may be an advantage, increasing the amount of insolation received on the 'adret'. The 'ubac' suffers a corresponding disadvantage, especially with regard to soil temperature. The factor of slope may however cause reversal of the usual human significance of 'adret' and 'ubac'. If the former is steep and rugged, more favourable sites for settlements or roads may occur on the 'ubac' (as in the Doron Valley, Tarentaise).

✓ The use of slopes for cultivation carries with it the danger of soil erosion. ✓ In parts of the world which have been cultivated for many centuries (i.e. Europe, Asia) the inhabitants are usually fully aware of the danger and have worked out a balanced land use which maintains the soil in position, either using terraces or leaving vulnerable slopes under pasture or forest. ✓ Even where such a balance has been reached however there are frequently signs of man's carelessness in the past; China and the Mediterranean lands both have denuded hillsides resulting from the destruction of forests in the past. In areas of newer settlement (e.g. the Appalachian Mountains)

appalling damage has been done. Settlers unaccustomed to mountain cultivation have tilled the land without the necessary precautions and each generation has done its share of inducing soil wash and gullyng, steadily ruining the land and their own livelihood until only a large scale all-embracing enterprise such as that of the Tennessee Valley Authority can tackle adequately the restoration of the region to productiveness and prosperity.

In areas of heavy precipitation in the form of snow steep slopes bring the danger of avalanches. These cause tremendous damage to mountain property. They are likely to occur after a blizzard, either because the sun reduces the coherence of the snowflakes or because snow hardened under the influence of wind may form 'windslab' and break up into massive blocks which slide down. The avalanches of spring are especially numerous and dangerous; as a result of melting the snow becomes slushy and incoherent, and meltwater from above is liable to percolate the snow and detach it from the underlayer. These big spring avalanches may collect earth and stones as well.

Though the atmospheric and snow conditions on which depend the occurrence of avalanches are very intricate and variable, their location is largely determined by the constant factors of exposure and slope. Danger areas are therefore known and settlement avoids them as far as possible. For example in Switzerland the Lötschental is a valley much affected by avalanches; the villages are placed in the safest situations, the houses crowded closely together; often in winter they are cut off from each other and the outside world by the frequent avalanches. Villages in dangerous situations are sometimes protected by the building of wedge-shaped or slanting walls above, but these are expensive to build and not very durable. It is in the seasons of excessive snowfall, such as the early part of 1951 that the worst tragedies are likely to occur, since villages normally considered safe may be overwhelmed (e.g. Andermatt near the St. Gotthard Pass).

Landslides may likewise occur after excessively heavy rainfall, damaging settlements or interrupting communications (e.g. in the Ticino valley, November 1951, blocking the Simplon line). A catastrophe of this type can be produced by man's carelessness, such as the obliteration of the villages of Elm and Müsli in eastern Switzerland in 1881, as a result of the undermining of a mountain by slate quarrying at its base.

Where narrow valleys with steep slopes dissect a mountain area which is at least partly of a plateau type, the lack of agricultural opportunity in the valleys may be compensated for by the possibility of using the rolling plateau surface for cultivation if the climatic conditions are favourable. This is so in southeast Denbighshire; the villages (e.g. Pont Fadog, Llantsantffraid Glyn Ceiriog, and Llanarmon in the Ceiriog valley) are in the valleys at about 500 feet, where there is practically no flat land; then above very steep slopes cultivated fields appear on a plateau level of 1,000 to 1,400 feet fringing the higher heather-clad plateau of the Berwyn Mountains. Isolated farms occur just below the plateau in the Ceiriog valley and in sheltered spots on the plateau, e.g. at the head of a small but deep tributary valley. The Pyrenees in Navarre show the same sort of thing; they are dealt with in more detail farther on (p.24)

NATURE OF SOILS AND LANDFORMS.

In the processes of erosion in mountain areas landforms are evolved which are significant for settlement. There is a plain differentiation between the denuded upper slopes and the accumulated deposits in the valley. The distribution and situation of the latter are particularly important in determining the characteristics of settlement. Nearly all mountain areas have been glaciated in the past even if they are not in the present, so that glacial landforms are very frequent. The existence of moraines and terraces on valley sides has often increased the habitability of an area by providing good well drained soil and a more level surface for cultivation and settlement. The 'shoulder' characteristic of many glacial valleys is often of great use for summer pastures and for hay, thereby extending the economic possibilities of the valleys. Of the results of river erosion the most important are the alluvial cones which, like terraces, may have the advantage of being above a marshy, easily flooded valley floor. Alternately in a dry climate they are likely to have water available. Good soil which has accumulated in an enclosed basin among rugged hills is also of importance from the human point of view.

This influence of minor landforms may best be made clear by some examples. For instance in the Austrian Alps, in the Inn valley the 'Mittelberg' terraces are very pronounced features and are favourable for settlement.

The villages on them are safe from floods and above the valley mists and the more extreme temperatures of the valley bottom. They are also subject to the warm Föhn wind from tributary valleys. In these circumstances a varied agriculture is possible including among the crops maize and wheat, peaches and apricots. Farther east in Austria the valleys of the Tauern range show different types of settlement according to their physical character. Those which are simple glacial troughs (e.g. the Habachtal) are nearly deserted, having only poor pasture covered with rock debris, and forest on the steeper slopes. Others such as the Kaprunertal, have developed a series of steps with flatter areas where there are little hamlets whose inhabitants are shepherds and woodcutters. The longitudinal valleys are much more populated; villages are usually on alluvial cones and barley and rye can be cultivated (though they have to be dried on racks). The valleys on the south side of the range are much more developed than those on the north side; they are both warmer and drier, settlement and cereal cultivation extending up to above 5,000 feet. This is altogether a rather backward part of the Alps, less affected by the modern development of communications than the centre and west.

The importance of alluvial fans may be seen clearly in an arid and barren region such as the Andes in Bolivia. In the Salta region of north-west Argentina the importance of intermont basins with alluvial filling is exemplified, streams from the surrounding mountains supplying water for irrigation.

WATER SUPPLY

Generally speaking mountain areas are wetter than lowlands and therefore water supply is easier. Even in a dry climate or one with a prolonged dry season there is more chance of water being available for irrigation, especially if there are glacier-fed streams which provide a steady supply. This may however involve bringing water some distance by means of aqueducts, such as the 'bisses' of the Valais in the dry sheltered Rhone valley, or, in the Karakoram mountains, the aqueduct bringing water from the glaciers of Rakaposhi for the Hunza valley. In many places where such aqueducts are not necessary a multitude of small channels from a nearby stream may water both crops and pastures.

In the siting of individual settlements water is a matter of marked importance, often deciding whether there is dispersed or agglomerated settlement. Limestone areas for instance, usually have agglomerated settlements owing to the lack of surface water, especially in areas of 'Karst' topography, where settlement is restricted to dolines and poljes where soil has accumulated and water is available, as in the Dinaric region of Jugoslavia.

TYPE OF FARMING.

X The type of farming carried on is conditioned by the factors already mentioned and at the same time assists in determining the type of settlement. Arable farming is confronted by obvious difficulties which in general relegate it to relatively lower areas and gentler slopes, but the difficulty of finding level areas is frequently overcome by the device of terracing, especially where there is pressure of population. The practice is often combined with irrigation; in a warm climate (e.g. south China) or with a southward exposure (e.g. the southern side of the Alps in north Italy) this kind of intensive agriculture may be very productive.

Stockrearing, with or without some subsidiary cultivation, is far more typical of mountain areas and may be carried up to very high levels, right up to the snow-line with the use of high pastures in summer, with associated temporary habitations. The 'alpine' type of farming economy spreads far beyond the region from which it takes its name, to Norway and the Carpathians, to the Caucasus and the Himalayas. It is a mixed economy in which cultivation, stockrearing and forestry all play their part in varying degrees. Land for fodder crops is limited, but can be freed for cultivation by the moving of animals up to the summer pastures, sometimes with an intermediate stay at the 'mayen' or 'veralp'. The intermediate areas may also be used for extra hay and forage crops to supplement those produced in the valley. The corresponding type of settlement consists of a permanent village, usually in the valley bottom or on a terrace where the main arable areas are, and related temporary settlements at one or two higher levels to which part of the population migrates in summer to look after the animals, make cheese, cultivate crops such as oats, barley or rye, and cut hay. The villages and intermediate settlements are usually in the forest belt and wood is the pre-

dominant building material; the 'alpine house is characterised by the combination of haybarn, stable and living quarters under one roof, with overhanging eaves and balconies.

The type of farming is also affected by economic conditions. It may be purely subsistence farming if there is barely sufficient production to provide for the population and particularly if there is no reasonably accessible market on account of distance or topographical difficulties. For instance the transhumance economy outlined above may or may not be tied to the farming of the neighbouring lowlands. In the 'greater' transhumance flocks are received from the lowlands in summer and the pastures hired out to lowland owners, e.g. in the French Alps and in Spain where flocks travel considerable distances, in modern times by train. Alternatively, inverse transhumance takes place when the mountain owners of flocks send their animals down to hired winter pastures. During the last hundred years there has been a tendency for transhumance to decrease in Europe owing to improved methods of cultivation of fodder crops, the irrigation of pastures and the use of chemical fertilisers which make the migration of cattle and sheep less necessary.

In the lower mountains of tropical south-east Asia there is no relationship between mountains and plains such as exists in Europe. Mountains and plains here are 'completely alien from each other. The people of the plains grow their rice and other crops on their own bit of ground. The hill peoples practise shifting agriculture in clearings, usually communally owned. The land is cleared by burning, usually on a west-facing slope, to avoid cooling by the rapid evaporation of the dew at sunrise. Usually they grow rice and maize, perhaps millet, sweet potatoes and some vegetables. Methods are generally more primitive than in the plains and in some parts, especially in Malaya, Celebes, Sumatra, Borneo and Indo-China, there are tribes who are still in the 'hunting and gathering' stage of development.

In the Andes of South America which also differ from European mountains in both greater scale and greater aridity the relations between pastoralism and agriculture also differ. Often there is a sharp contrast between the sedentary oasis communities tied to their irrigated lands and the nomadic pastoralists whose dwellings, in so far

as they have any permanent homes, are in the high valleys, but who are driven down to the environs of the oases by the bitter winds and snow of winter. Yet these two groups are mutually dependent and must exchange their products. Sometimes however the farmer is both herdsman and cultivator, becoming temporarily nomadic when his home pastures are exhausted. This is true of the settlements at the edge of the Bolivian plateau, situated on the piedmont belt of alluvial fans. Where mining has developed, the occupation of favourable sites for cultivation has been stimulated by the market thus created for vegetables, barley, meat, etc. (7).^x

In Africa most of the better pastoral areas are on the heights, as the plains are either forested or else savanna with poor soils and therefore offer little good pasture (and in many areas are afflicted with the tse-tse fly). The extent to which the highlands are occupied depends also on the race. The peoples of Abyssinia show the most marked preference for the highlands. The cultivated and populated zone of the 'voinadega' lies between about 5,500 feet and 8,000 feet; it has no excessive temperatures and has the advantage of a reliable and well distributed rainfall. The southern half of the Ethiopian massif is more agricultural; the drier and cooler north is stockrearing country. Addis Ababa stands at 7,874 feet. In 'Travels in Ethiopia' David Buxton describes the country near Debra Berhan, 80 miles north-east of Addis Ababa, a plateau region covered with short grass and clumps of trees. The people live in isolated homesteads rather than in villages. At the eastern edge of the plateau the rivers plunge down into deep gorges which have a considerable population since there are 'shelves' on their slopes where crops grow better than on the exposed plateau.

Other examples of mountain population in Africa are found in Ruanda Urundi (where the population density is 200 per square mile as compared with 15 per square mile in Tanganyika), the Wadai east of Lake Chad and Adamawa south of that lake, all of which have better agricultural and pastoral resources than the poor savanna. The Kenya highlands are, after Abyssinia, the most considerable area of highland in Africa over 5,000 feet within the tropics, and the Kikuyu Plateau (5,000 to 8,000 feet) is one of the most densely populated parts of that continent.

(7) Bowman, op. cit. p. 497.

The deep rich soil is derived from volcanic tuffs and it is retentive of moisture and also light to work. The Aberdare Plateau is less fully occupied, much remaining forested. The great advantages of the plateaus are appreciated by the native Kikuyus and the European settlers alike causing difficulties in the division of land which are constantly increasing. The chief crops grown are sisal, maize, coffee and wheat.

Transhumance has not developed much in Africa; where it does exist it is the dry season which causes the migration upwards. It is limited because many of the tropical animals cannot stand lower temperatures; it is mainly where there are sheep, e.g. in Abyssinia, that they go to any considerable height. In the Drakensberg of South Africa sheep go up from Natal and from the Orange Free State and the Transvaal from May or June to September or October. In Basutoland the sheep and goats stay in the mountains for the whole year; only the cattle move. In the equatorial regions on the other hand the vegetation is usually unsuitable, since almost impenetrable bush may cover the slopes to near glacier level.

In North Africa the mountains are usually a refuge from aridity, and oases appear in the Saharan heights of Haggar, Air and Tibesti. The streams which irrigate the crops of dates, wheat, barley, tomatoes, onions, disappear into the sands at the foot of the mountains. The wetter mountains of the Atlas region are less dependent on irrigation and fruit growing (vines, oranges, olives, figs, almonds, peaches) is the dominant type of farming.

The detailed examples which follow include alpine settlements, Reichenbach (Kandertal) with a typical economy, the Val d'Anniviers with its seasonal nomadism, and the massif of Devoluy, a sheeprearing region. There are two examples from Spain, the Pyrenees of Navarre and the Picos de Europa. The Hunza valley in Kashmir and the Bolivian altiplano provide two from the greater mountains of other continents.

REICHENBACH AN ALPINE VILLAGE

Reichenbach, a typical Alpine village, lies in the lower Kander valley about 4 miles south of Lake Thun, and just below the confluence of a tributary, the Kien. The village is situated on the eastern slope of a drumlin terrace, its nucleus being about a third of a mile from

the river. The centre of the village is at 715 m., low for an alpine village; this is the extreme northern edge of the Alps; beyond Thun the Swiss Plateau begins. The valley here runs due north and south and is fairly open, but there is a considerable difference between the eastern and western slopes. The western slopes, besides losing the sun early, are much steeper; these are the lower slopes of the Niesen (2365 m.). This side of the valley is mainly forested with clearings for hayfields and intermediate pastures; above are alpine pastures, from about 1,400 m. upwards. There are no permanent dwellings on this side of the river except at Reudlen, right at the bottom of the valley.

The eastern slope is gentler, having a series of drumlin terraces which are utilised for settlement and cultivation. The proximity of alpine pastures permits the use of this valley land for hay (which covers the largest area) and for crops, potatoes, wheat, oats and vegetables. These are grown in a small patch on each farm (average size of farm about 7 acres), which is shifted every 2 or 3 years so that most of the holding is cultivated in turn. The grass is cut twice for hay; the main use of the valley land is to provide sufficient fodder for the winter months. The farmer's area of grassland limits the number of cows he can keep; few individuals own more than a dozen. The alpine pastures are communally owned; in the autumn the cheese made there is distributed according to the number of cattle each farmer has sent up to the alp. Also in the autumn he may sell some of his animals, because of lack of winter fodder or for cash for payment of taxes and purchase of clothing and farming equipment. The cattle sales take place at Thun, Bern and elsewhere on the plateau. The cattle are of the Simmental breed. Only the nearer alps on the Niesen and Engel Alp are shown on Figure 1.: the animals also go to the alps at the head of the Kien valley; in spring and autumn they spend some time on the 'mayens'.

Besides the village of Reichenbach there are several smaller settlements, Kien, near the confluence of Kien and Kander rivers, Scharnachtal, straggling up the Kien valley road, Faltschen on a higher terrace, and Mulenen a mile farther down the valley. At Kien there are two sawmills, and Mulenen another, witness to the fact that farming is not the sole support of the people; many have a 'second string'. The timber is cut on the Niesen

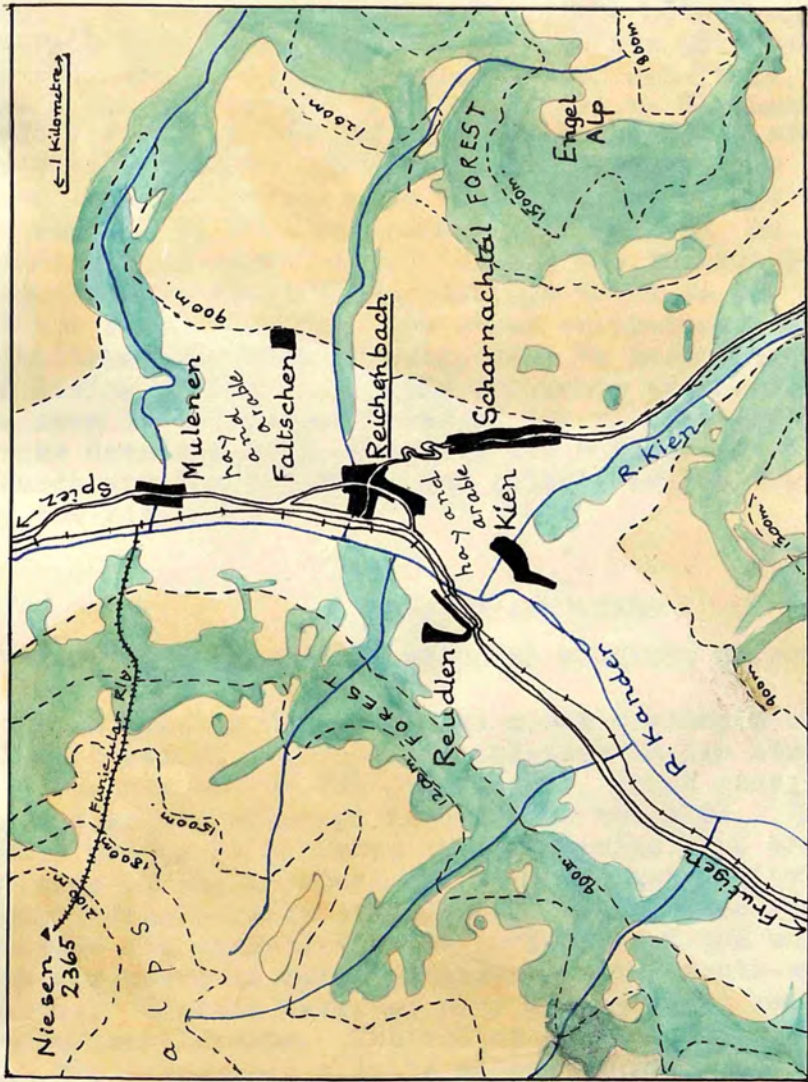


Figure 1. Reichenbach, Kandertal, Bernese Oberland.

slope and is sold beyond the valley besides being used for local building. There is a small factory making jewels for watches. Also besides the normal crafts of a fair-sized village community there is the tourist industry. This is on a small scale and only in the summer since it is too low for winter sports, but the village benefits from its position on a main line, the Lötschberg railway running from Basle and Bern through the Lötschberg Tunnel to Brig and so to the Simplon Tunnel and Italy. There are 6 hotels (small), 3 of which are in Reichenbach, receiving mainly French, Dutch and Swiss visitors. The attractive tributary Kien valley increases the importance of the village as a tourist centre, also the viewpoint of the Niesen summit, accessible by a cable railway from Mulenen, as well as the proximity of Lake Thune. However the tourist industry remains subsidiary to agriculture which is the basis of the local economy; the other occupations, followed simultaneously with farming, help to raise the standard of living of the area. The influence of the railway is seen in the present plan of the village which has grown down the hill, from its old nucleus round the church and the old Bären Inn (1542) towards the station by the river. (8)

VAL D'ANNIVIERS

A CLASSIC EXAMPLE OF SEASONAL MOVEMENT OF POPULATION

Jean Brunhes has given the classic example of the seasonal movement of a mountain population in his study of the economy of the Val d'Anniviers, which shows the most complete seasonal nomadism in the Alps. This north-south valley is situated in the Pennine Alps south of the Sierrane; a gorge at the northern end isolates the valley from the longitudinal trough of the Rhone valley (see Figure 2). Despite its orientation the influence of the sun is apparent for there is more settlement on the south-west facing slopes. Glacial terraces play an important part in the siting of settlements. The valley as a whole is sheltered and the favourable climate allows cultivation and vegetation zones to reach considerable heights (cereals to 1,900 m., forests to 2,000 m., with trees further up to 2,150 m., and there are alpine pastures up to 2,800 m.).

(8) This locality was studied with the Geographical Field Group, under the direction of Dr. W.B. Fisher.

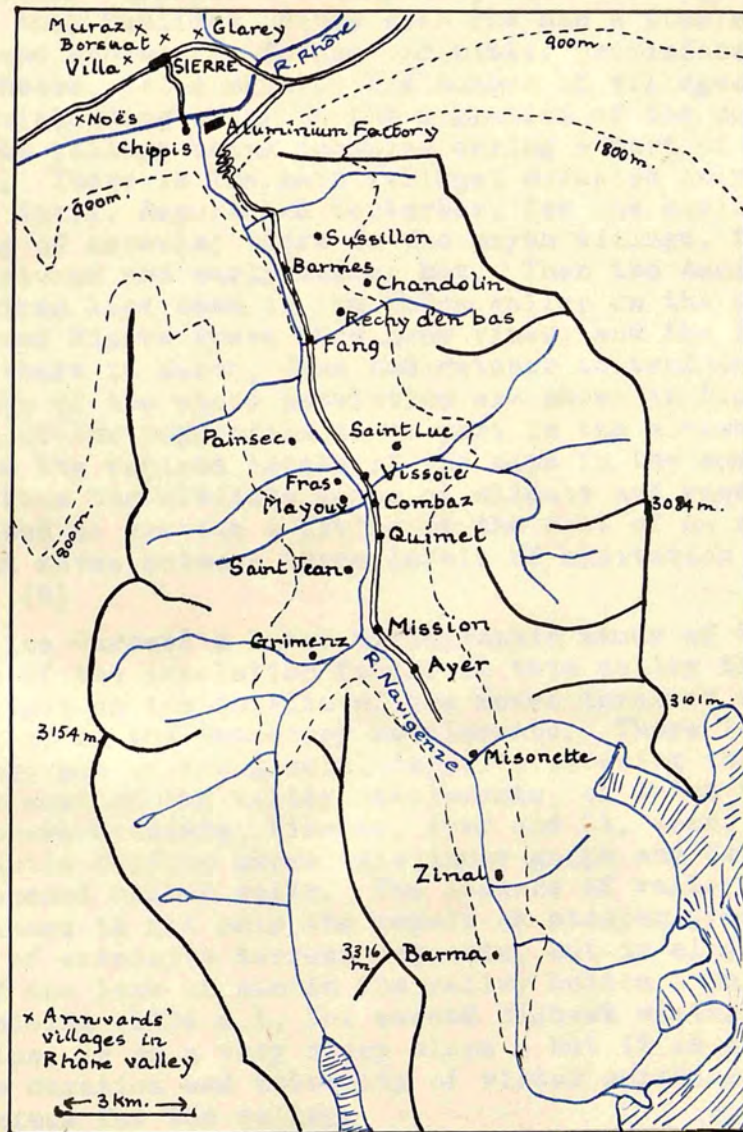


Figure 2. Val d'Anniviers (Swiss Valais).

The size of villages is deceptive, for there are more buildings than families, since each one has a stable and hayloft, and stores for forage and winter provisions (bread, cheese, dried meat). The number of villages is likewise misleading owing to the migration of the population, each village being occupied during a part of the year only. There is the main village, occupied only in February, April, August and September, for the sowing and harvesting of cereals; there is the mayen village, for autumn pastures and early summer hay. Then the Annivards have acquired land down in the Rhône valley on the sunny slopes round Sierre where they grow vines, and the family migrates there in March, June and October to tend the vines. These moves of the whole population are shown in Figure 3. Only part of the population takes part in the movement of the animals to the various levels of the alps in the summer months. Thus the altitude zones of climate and vegetation are utilised to provide a living at the cost of no fewer than eight moves between three levels of habitation during the year. (9)

Dr. Alice Garnett's later cartographic study of the operation of the insolation factor in this valley throws further light on the details of the moves involved and on the sites of the temporary settlements. There is an inner gorge but in the glacial deposits covering the valley floor and most of the valley settlements, of which the most important are Griments, Vissoie, Ayer and St. Jean, are on the gentle terrace above this inner gorge and below the over-steepened valley walls. The absence of valley villages below Painsec is not only the result of steeper gradients and lack of extensive terrace deposits, but is also the result of the lack of sun in the valley bottom. On the other hand Chandolin (1936 m.), the second highest winter village in the Alps, is on a very steep slope - but it is situated where the duration and intensity of winter sunshine are at their maximum for the valley.

Since the valley sites are generally least favourably placed with respect to the duration and intensity of sunshine, especially in winter, the unusual feature of reversed transhumance has arisen in some of the settlements. From the winter settlement of St. Luc the people descend to the spring mayens at Barmes, and from Chandolin they

(9) Brunhes & Girardin. Val d'Anniviers. Ann. de Geog. XV. 1906. p 329 - 352.

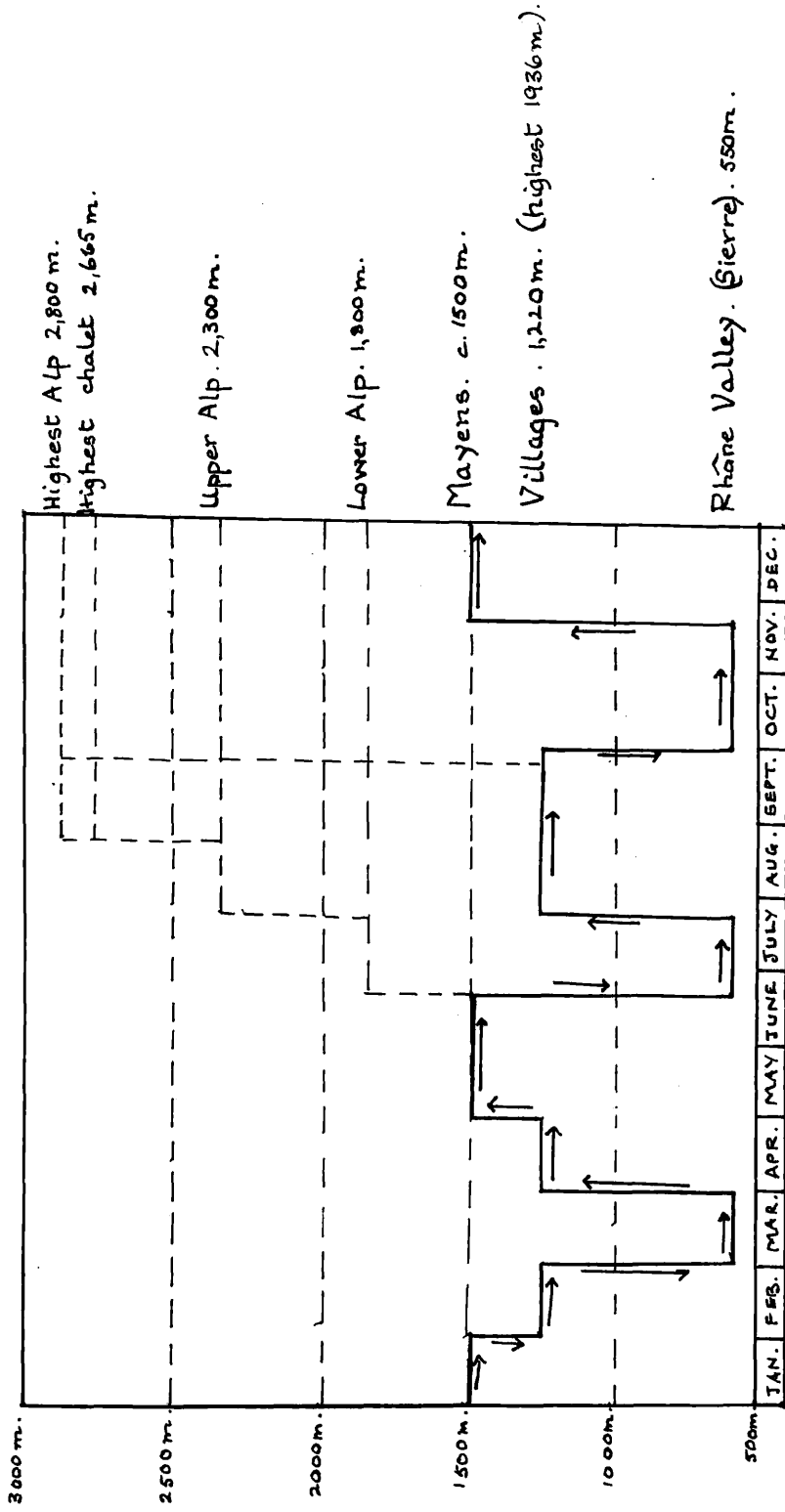


Figure 3. Seasonal migrations of the population of the Val d'Anniviers.

go down to Le Rechy and Sussillon. From Grimentz and Ayer there is a winter movement up to a temporary settlement at Zinal. The general distribution of valley settlements can be accounted for by considerations of relief and soil but the exact positions show the strong influence of local changes of aspect giving higher intensity of sunshine. The lower end of the valley is shown to be at a definite disadvantage from all points of view and consequently only minor temporary settlement uses it. (10)

DEVOLUY

SHEEP PASTURES IN THE LIMESTONE PRE-ALPS

Devoluy, the highest of the prealpine massifs in the French Alps, covers an area about 12 miles square in Dauphiné at the southern end of the subalpine Trench. It lies between the valleys of the Drac, on the north and east, and of the Grand and Petit Buech on the west and south. Its structure is synclinal and sharp limestone ridges bound it on east and west, with more individually defined mountains on the north and south, shutting in a wide bowl which is quite concealed from the outside of the massif; from Corps in the Drac valley Devoluy appears as a fierce rugged limestone group with nothing to suggest the possibility of settlement and agriculture. Indeed it proved an excellent refuge for members of the French Resistance movement during World War II. The northern section of the eastern wall is formed by the Montagne de Féraud, a continuous ridge about 6 miles long running south to the Col du Noyer, south of which again the sharp limestone crests continue for another 5 miles. The col is the only break, through which a rough road leads down to the valley of Champsaur. The 'Field of Gold', a main routeway (the Route Napoléon, from Grenoble to Gap and the south) and a fertile valley with many villages among its woods and fields provides a sharp contrast to the isolation of Devoluy. (see Figure 4).

Northwards the only road leads down the valley of the Souloise through a narrow rocky defile north of the village of St. Disdier between the Tête de l'Obiou (2,790 m.) and the lower more rounded mass of the Gigon. The road

(10) The maps and detailed study of the area by Dr. Garnett are to be found in the Transactions of the Institute of British Geographers No. 5. Insolation and Relief, 1927, p. 11 - 21.

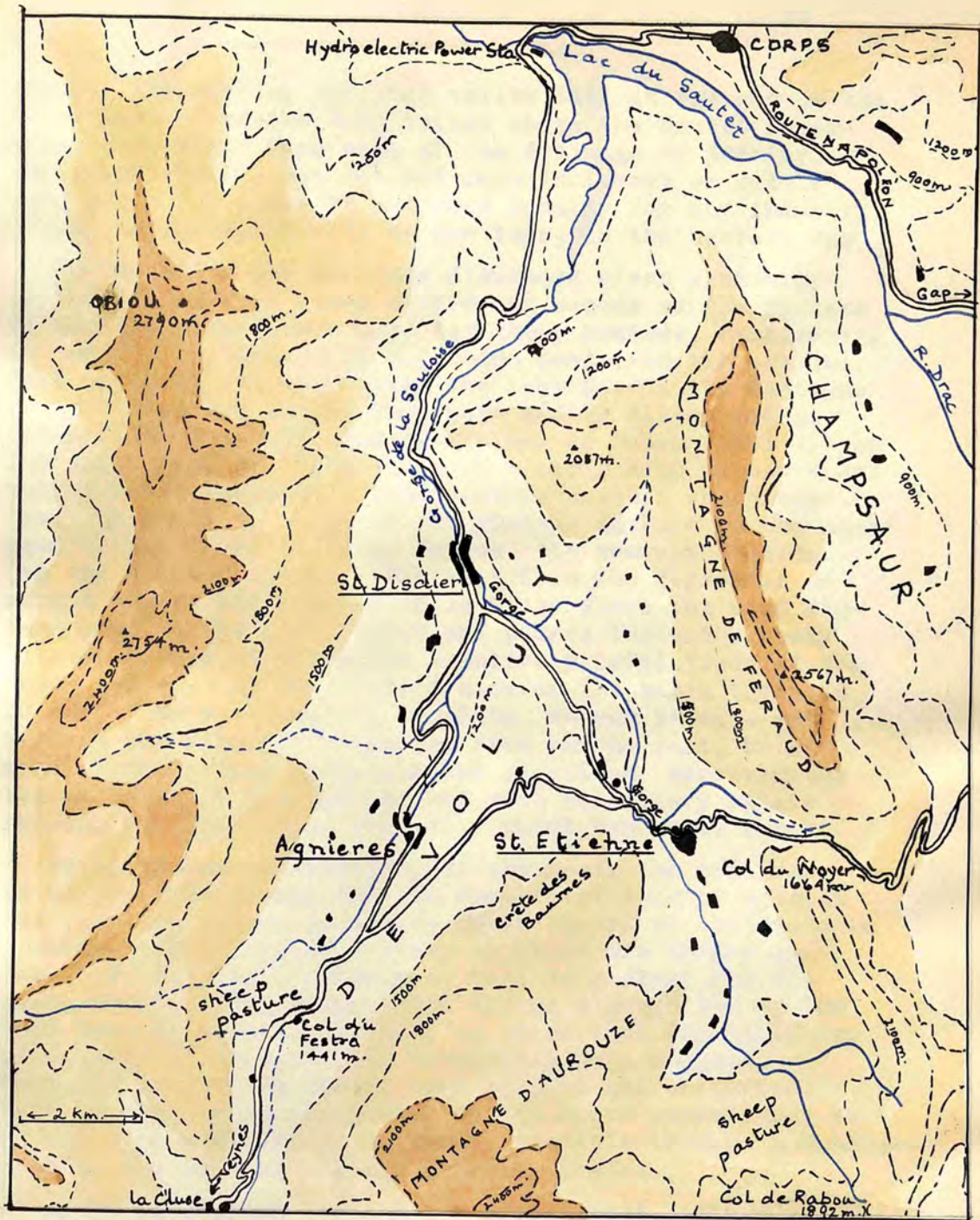


Figure 4. Massif of Devoluy, Dauphiné Prealps.

follows the winding forested valley till it emerges on the broad terrace of the Drac valley above the Sautet reservoir, into which flows most of the drainage of Devoluy. The power station has not had much influence on settlement since the power is not used locally for any industry. Corps, on the north side of the lake, is the nearest town.

To the south the Montagne d'Aurouze rises gradually to the foot of the steep cliffs and screes of the Plateau de Bure, a stony waste used for sheep pasture, culminating in the Pic de Bure (2712 m.) which dominates the skyline. East of it is the much lower and less formidable Montagne de la Plane, and beyond that more gentle slopes and an ill-defined footpath lead to the Col de Rabou (1893 m.) on the south side of which there is a steep drop to the Buech valley whose forested depths provide another sharp contrast to Devoluy. West of the Plateau de Bure is the third road outlet going south to Veynes, the nearest station (on the Briançon line). The exit from the region is an abrupt one at the village of la Cluse where the road zig-zags down to the river Bécoux and passes through a rocky gateway before reaching the relatively level floor of the Buech valley. On the western side of the basin there is no exit; the rock wall is complete, though it does not present the straight crestline seen on the east, being more variable both in height and direction; moreover the slopes below it are more broken with subsidiary ridges running out eastwards, generally about two miles long.

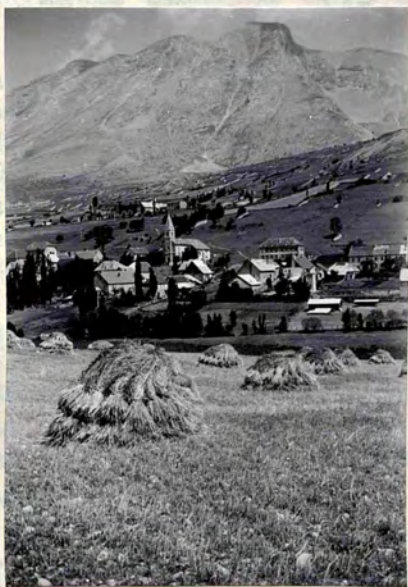
Owing to the permeability of the rocks the drainage is mainly underground and the consequent lack of erosion has resulted in the generally gentle slopes of the basin as a whole. Such surface streams as exist are deeply entrenched, flowing for the most part in gorges; for example at St. Etienne the river enters a gorge 150 to 200 feet deep with vertical walls so close that the width can be spanned by outstretched arms (Plate Ic), suggesting that the roof of an underground channel has collapsed; this impression is heightened by its close resemblance to an existing underground channel accessible through a swallow-hole in the wall of a gorge near St. Disdier.

As in an English lowland the predominant pattern of the landscape is laid down by its hedges, so it is in

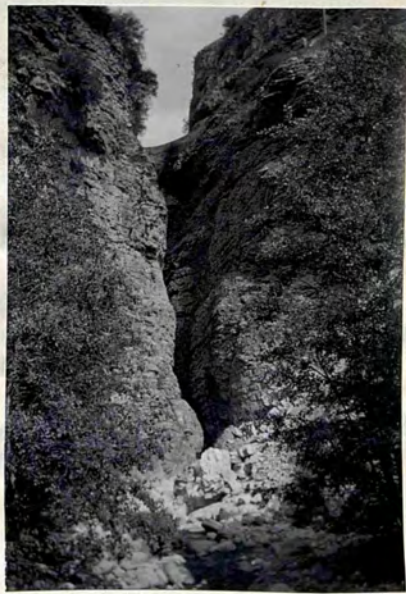
PLATE I
DEVOLUY



a. Looking northwards across the basin.
The peak hidden in cloud is Obiou(2790m.).



b. St. Etienne
Mt. de Feraud behind.



c. Upper end of gorge
below St. Etienne.

Devoluy by the ubiquitous piles of stones (Plate IIc). They are to be seen by every field, sometimes just piled in the middle, sometimes forming a rough boundary. These are merely the larger stones; the soil is still full of the smaller ones; nevertheless despite this stony soil Devoluy has a larger percentage of its area (7%) under cultivation than the other prealpine massifs and it has not suffered so much from depopulation; in fact it is more prosperous now than in the past when it suffered from a bad reputation as to the severity of its climate and its generally inhospitable character. Its economy rests upon animals, especially sheep, of which there are over 700 per 1,000 inhabitants; they are partly native and partly originate from Arles, where they are bought in the spring and are brought up to the extensive high pastures which are the real wealth of the region (Plate IIa,b); the lambs are sold in the autumn.

Cattle though less important are also numerous, 55 per 100 people; out of about 700 animals some 500 are dairy cattle; they are fed near the villages; the crops, except for potatoes, are almost entirely fodder crops. Their saleable products then are two, lambs and milk.

The pattern of settlement is one of small hamlets and a number of isolated farms with 3 villages, St. Disdier, Agnieres and St. Etienne, each of them of the 'strassendorf' pattern. Aspect and slope combine to site the St. Disdier and Agnieres groups of hamlets on the western slope of the valley; south-east of St. Disdier there are only scattered farms. Near Agnieres the contrast between slopes is more clearly marked as the valley here trends more from south-west to north-east and the slope has a more south-easterly aspect; also these 'adroit' slopes are gentler than the average, whereas the 'ubac' is steeper. The slopes on both sides become more moderate as they rise to the Col du Festre and its wide expanse of pasture. The highest settlement in the area stands on the pass, at 1,441m.

In the St. Etienne group the situation is reversed. There the most favourable slope faces west-south-west. On the whole there is not so much contrast here; it is true that St. Etienne and the three hamlets lie on the eastern slope, but farther up the valley changes its direction and the east side begins to be broken by gullies; then the farms appear on the west side. In most cases

PLATE II
DEVOLUY



a.

U.G.

a. Sheep pastures.
Montagne de la Plane.

b. Sheep pastures near the
Col de Rabou.



b.

R.H.



c.

R.H.

c. Fields near the Col du Noyer.
Typical piles of stones
gathered from the fields.

d. Pic de Bure, looking S.
from St. Etienne.



d.

R.H.

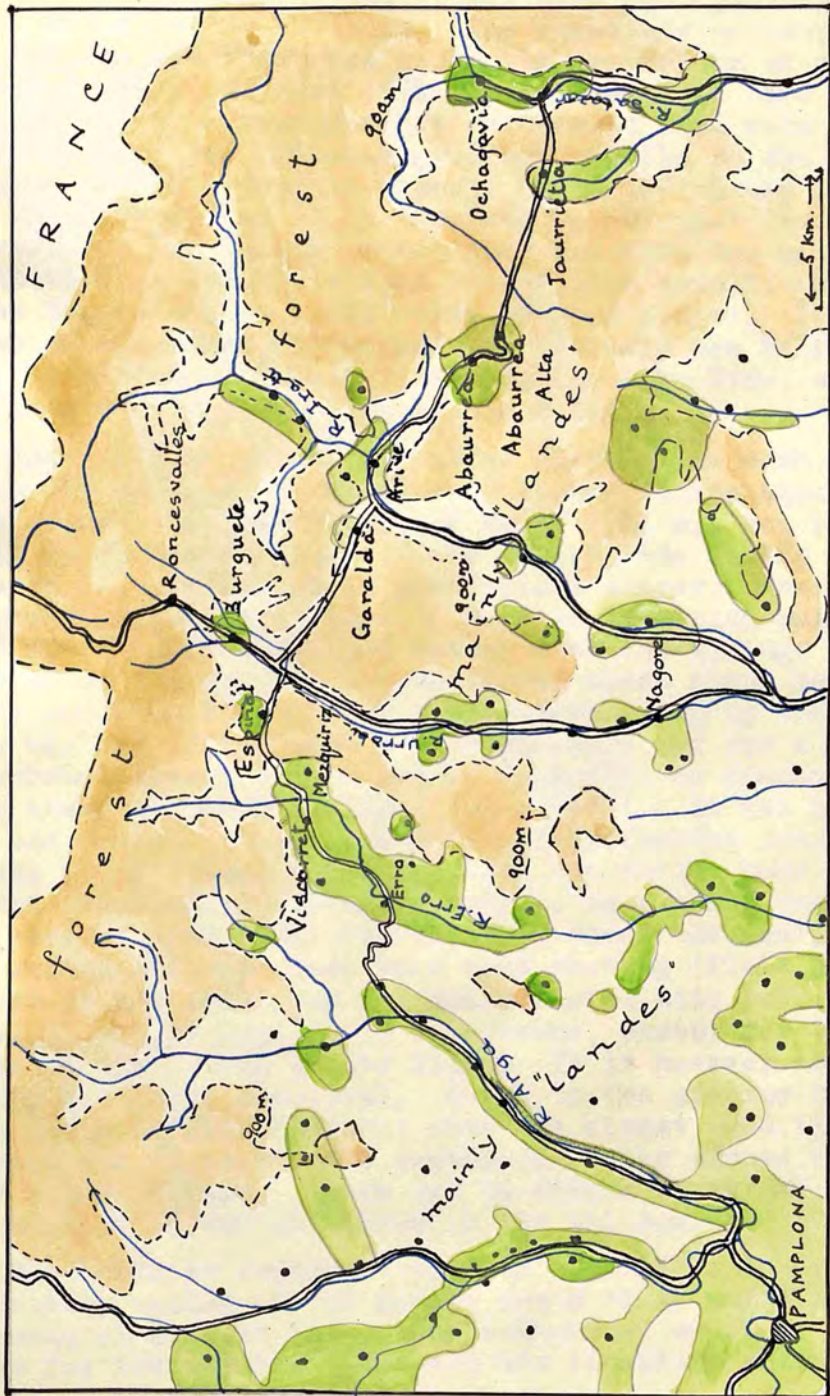
the houses lie along the road or path but the three hamlets a little north of the St. Etienne gorges are of quite a different character, lying off the road with houses grouped haphazardly. The 'capital' of Devoluy, St. Etienne, (Plate Ib) is situated at 1,280 m., on the eastern slopes where the road, having descended in zigzags from the Col du Noyer, is joined by a by-road before traversing the gorges, a passage achieved by means of a brief tunnel and three bridges. The village consists of the church, 3 or 4 farms, a dairy where cheese is made, the gendarmerie, a hotel and two cafes, a youth hostel, a grocer's shop and a few other houses. The village street, running along the slope, is fairly gentle, but the angle of the slope is considerable; the roof of the house opposite the church is on a level with the floor of the church.

This survey is not complete without emphasis on the position of the area as well as its local characteristics. It is clear that its economy is very much influenced by the relative proximity to the Mediterranean lowlands of France so that it has been for centuries caught up in the great transhumance movements.

AGRICULTURAL SETTLEMENTS IN PYRENEAN NAVARRE

BURGUETE AND THE NEIGHBOURING REGION

The southward slope of the Western Pyrenees in Navarre presents a situation in which the interfluves are of more value for cultivation than the valleys (see Figure 5). There is a structural surface at about 700 to 900 m. sloping gently southwards; as this was uplifted the rivers dissected it. Each valley consists of a series of gorges alternating with open stretches which are sometimes former Karstic depressions later captured by the rivers. The Urrobi valley provides a good example with gorges below Nagore and below Burguete; the latter site has special features which will be dealt with below. The relative advantage of the undulating plateau surface at about 800 - 900 m. over the restricted valleys can be illustrated well by comparing the village of Erro (688 m.) in the Erro valley with Espinal, just over the Puerto de Espinal by which the road passes from the Erro to the Urrobi valley. Erro itself has a quite typical position on a spur facing south-east. The poverty of the valley floor



Only villages mentioned in the text are named. Cultivated areas (Lefebvre. Les Pyrénées Atlantiques Orientales)

Figure 5. Valleys of Pyrenean Navarre.

below it can be seen; the fields have bare patches where the rock actually outcrops. The immediate neighbourhood of the village therefore gives the impression of agricultural poverty. Espinal (871 m.) on the other hand is surrounded by a considerable cultivated area with oats, barley, flax and potatoes growing, chiefly on the gentle slopes with a southerly aspect. On crossing the pass back to the Erro valley it is possible to see that the apparent poverty of the valley is illusory for from the pass the cultivated areas above that valley also appear, cut off from the valley by steep scrub covered slopes. The villages of Mesquiriz, Viscarret and Linzoain are halfway up the slopes, not down in the valley like Erro, and so have more fields close to the village.

Farther east the Irati valley (Aezcoa) is much narrower than the upper Erro (which is a former doline captured by the river) and the village of Arive (701 m.) has practically no cultivable land in the valley, the fields again lie on the plateau above precipitous slopes. There is a contrast with the village of Garalda in a side valley at 843 m. This is a hanging valley with the village nicely placed in the centre of a sheltered basin about half a mile wide and a mile long with a limestone scarp to the north. The village is prosperous in appearance and has a recently concreted street with a kerbed footpath, an unusual adjunct for these mountain villages (Plate IIIa). It has spread up on the 'adret' (where the street deteriorates into the more usual stony track) and also along the valley road. The ubac, except immediately above the houses, is wooded; the adret is covered with small fields; then comes the scarp, thickly wooded but with some bare rock showing (Plate IIIb); above it are small hay and grain fields with surrounding hedges, almost English in appearance, except for the small size of the fields (Plate IIIc). It is however about 1,000 ft. above sea-level. Owing to the greater heights to the south Garalda does not have the almost 'Mediterranean' aspect and vegetation of southward facing slopes in Aezcoa and other valleys. There are no dispersed farms; the population of 400 all lives in the village.

The basin is separated only by a slight rise from a tributary valley of the Urrobi basin which continues the structural feature (an eroded anticline) which is responsible for the Garalda basin and the limestone scarp. This

PLATE III

NAVARRE



a.

R.H.

a. Garalda. Main street of village, looking north with limestone scarp behind.

b. Fields on adret below the scarp.



b.

R.H.



c.

R.H.

c. Cultivation on the plateau above the scarp.

makes it equally easy for the villages to attend the markets in Arive or Burguete to sell their animals (cattle, sheep and goats) and potatoes and to buy provisions, clothes and machinery. There is also a daily bus service to Pamplona, coming from the villages of Abaurea Alta and Jaurieta away up on the other side of the Irati valley on the rolling plateau which between its cultivated areas is still forested.

Burguete (Figure 6) is unique in its situation. It is in the middle of a small plain of about 4 square miles in extent (Plate IVa), the floor of a former doline which was captured by the river Urrobi, 900 m. above sea-level, and sloping gently southwards, the surrounding hills rising 200 to 300 metres above it. This gives it a deceptively lowland appearance; it is also very green as at this height it has plenty of rain and can be completely engulfed in clouds, as it receives damp air from the Bay of Biscay (Plate IVc). It is much wetter than the Erro or Irati valleys. The land immediately round the village is cultivated, growing oats, barley, potatoes and other vegetables. Potatoes occupy a good deal of the arable area; there is no wheat or maize and the harvest is later here than in the neighbouring valleys. Cultivation is related to the important animal husbandry; oats and barley are grown to feed the horses bred here, and the land is left under grass for several years in the rotation. Beyond the arable fields pastures and heathlands extend towards the foot of the hills, merging into the forest. There are plenty of animals, cattle, sheep, horses and goats. Cattle are reared for field work and are sold at 2 or 3 years old; the horses roam loose in the summer but are taken in to the village in the winter cold; they are sold at Pamplona at 4 or 5 years old and go mainly to Barcelona and Valencia for field work. The sheep, reared mainly for wool, go up to the higher pastures on the hills in summer. Each farmer has several goats; these go out each day with the communal goatherd. In the past there was considerable transhumance across the border into and out of France.

The village itself consists of a long street of substantial stone houses with yards behind them (Plate IVb). Certain non-agricultural factors have influenced it; these are dealt with in section IV. From the agricultural point of view the main features are that owing to

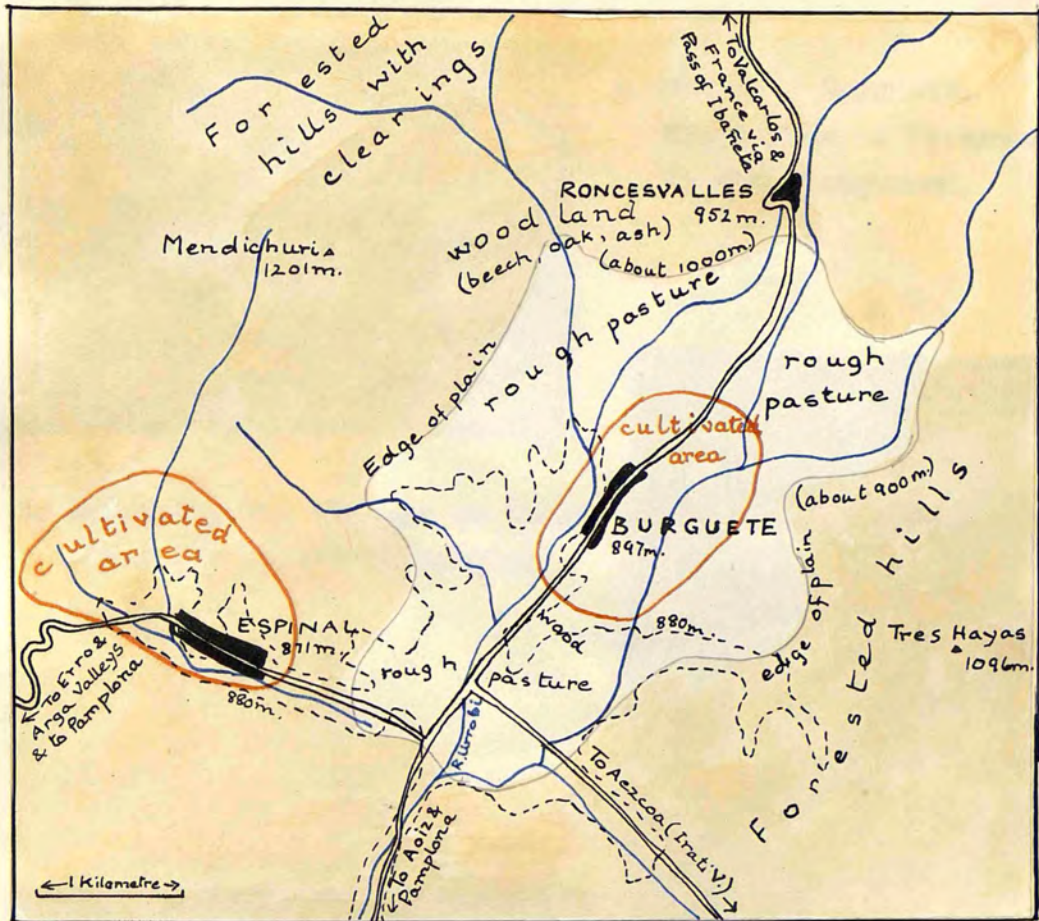


Figure 6. Burguete and Roncesvalles, Navarre.

PLATE IV

NAVARRE



a.

R.H.

a. Plain of Burguete.
Crest-line of Pyrenees
in the background.

b. Burguete. The village is built
along the road from Pamplona
to France.



b.

R.H.

c. Clouds creeping over
the crest-line. Damp
air from the Bay of
Biscay keeps Burguete
green.



c.

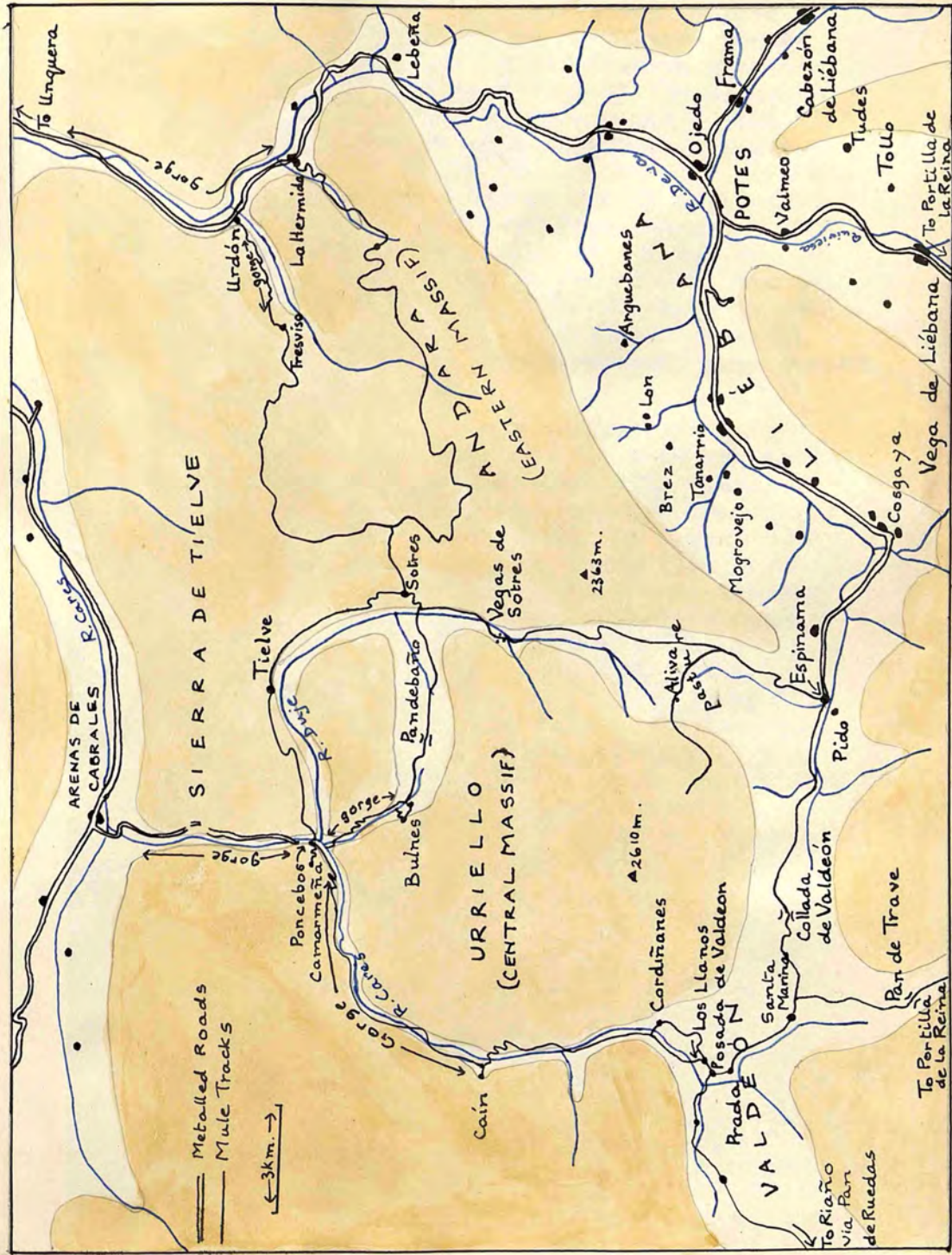
R.H.

the flatness and openness of the basin and its height it has more of the characteristics of the villages on the plateau than in the valleys. It is more exposed to the westerly winds and this is reflected in its extensive grazing and forest lands and in the emphasis on stock-rearing.

PICOS DE EUROPA

The Picos de Europa (Figure 7) is a limestone massif in Northern Spain, north of the main Cantabrian chain and separated from it by two deep valleys, Liébana and Valdeón. The startlingly white limestone (Plate VIc) (Lower Carboniferous) with its abrupt cliffs makes a sharp contrast with the country of schists and conglomerates which lies to the south of it. It is a very hard limestone, sometimes dolomitic, and the higher parts of the range are a maze of strange rock forms; ridges and pinnacles separate 'hoyos' (Plate VIId), dolines in which the infrequent springs disappear to re-issue lower down. The rivers Cares and Deva rise on the northern flanks of the Cantabrian range and have cut deep gorges in the Picos de Europa limestone. As a result each river's course can be divided into three parts, (1) an upper basin between the Cantabrian divide and the Picos de Europa, (2) the gorge through the limestone range and (3) the lower course through the hill country immediately behind the coast (part of the Cares valley, occupying an east-west synclinal depression, forms the northern boundary of the eastern half of the range). The effects of geology, landforms, drainage and climatic exposure are all apparent in the nature and distribution of the settlements here.

Valdeón, the upper part of the Cares valley, between 3,000 and 4,000 feet in height, is a fairly open basin (Plate Va) with gentle slopes in the central part; it is separated from the Liébana, the upper part of the Deva valley, by an easy but fairly high pass (Collada de Valdeón, 5,965 feet). There is no dispersed settlement; in the centre there are 3 hamlets grouped together, Los Llanos (Plate Vb), and Posada de Valdeón (3150 feet) on either side of the most nearly level ground, and Prada (3334 feet), a little higher up the valley to the south-east. The fields by these villages are irrigated, growing



N.B. The colourwash is used to clarify the position of basins and gorges; its bounding line is not a contour.

Figure 7. Picos de Europa, Northern Spain, showing basins of Valdeón and Liébana.

wheat, maize, potatoes, grass and fruit trees (apples and pears). The houses lie above the most level ground leaving it free for cultivation. Slow creaking ox-carts are used by the farmers; their barns are of the Asturian type, 'horreos' perched on stone pillars about 4 feet in height; the space beneath is used for storing implements, or even as a pigsty (Plate Vb). There are also the villages of Cordinañes at the northern end of the basin, Soto de Valdeón in the south-west and Santa Marina, which lies at nearly 4,000 feet above a step in the valley, on a cliff overlooking the stream. The latter village has access to extensive pastures a short distance above as well as small terraced fields close to the village. For the most part the steeper slopes are scrub-covered, with forest on the higher Cantabrian ranges.

There are no metalled roads; mule tracks lead southwards over the Pan de Trave (5184 feet) to Portilla de la Reina and over the Pan de Rueda (4938 feet) to Riaño; the relative ease of these routes accounts for the historical link with León, in which province the region lies, rather than with Asturias although the basin lies north of the main watershed. The region has always been very isolated and still is; the shortest path leads to Liébana, itself isolated. Downstream to the north the way is blocked by the formidable gorge of the Cares (Plate VIa). Until recently only a suicidal trace of a path crept along its precipitous walls but in 1948 a good path, sometimes tunnelling through the rock and frequently overhung by it, was constructed after 6 years work. For many years a road has been projected to pass through this gorge and to reach Portilla de la Reina via the Pan de Trave, but so far it stops short at Poncebos; a rough bed extends a short way into the gorge beyond, but it is unlikely to be completed for many years, and most of it will have to be blasted out of the rock walls.

The walls of limestone rise above the northern end of the basin at Cordinañes and here the gorge starts. The sharp fall in level is used for a small hydro-electric power station for local needs. The first section of the gorge has some wider stretches where there are pastures and shepherds huts. At Cain the narrowest section begins; the river is dammed at a point where the side walls are vertical and a canal, flowing for the most part in a tunnel, carries the water to Camarmeña, from which point there

is a fall of 900 feet to the power station at Poncebos (Compania Electrica de Viesgo) (Plate Vc). A metalled road starts here and traverses the rest of the gorge to Arenas de Cabrales.

The narrowness and depth of the main part of the gorge preclude any settlement. At the bottom it is no wider than 12 to 20 feet and the walls are up to 4,000 feet high. Above it on each side are the sharp limestone peaks separated by 'hoyos' and an occasional deep gully running down into the gorge. The small village of Cain (Plate Vd) just above the dam seems to be at the bottom of a hole, surrounded by towering walls of limestone. There are a few fields by the two hamlets, each of half a dozen houses, which make up the village. Maize is grown, and used to fatten pigs for their meat supply. The village is dependent on scattered pastures in the hoyos far above the village (which is at 1,680 feet; the 'majada' in the Cañal (i.e. gully) de Debressenges one mile away is at 5,000 ft.) reached by precipitous paths which all too frequently cause casualties among the inhabitants; in fact the people of Cain are proverbial in Asturias for their dangerous mode of living and their hardihood. They are good-looking when young but their hard life soon ages them.

Opposite the confluence of the Duje with the Cares is Camarmeña at 1615 feet, 700 feet above the river, with steeply sloping small fields, the only site below the dam which is feasible. The power station, the start of the metalled road, and the junction of the Bulnes stream and the Duje with Cares, make Poncebos below Camarmeña a focal point marked by the existence of a 'fonda' (inn); there is no room for anything more. Six kilometres down the road is the small town of Arenas de Cabrales from which a daily bus service connects with the railway at Unquera, 30 kilometres away on the coast.

The village of Bulnes (2280 feet), the only one in the Central Massif of the Picos de Europa, is two hours away (horizontal distance means nothing here) up a side valley through a gorge as savage as that in the main valley. It is as deeply set in the mountains as Cain; two hamlets crouch in a hollow 3,000 feet deep, each with about eight or ten houses, one, containing the church, by the river, the other 200 feet above on the edge of a cliff. The houses are primitive; a small kitchen, with smoke-black-

PLATE V
PICOS DE EUROPA



a.

R.H.

a. Valdeon. Looking south
across the basin.

b. Los Llanos. Hamlet in Valdeon.
'Horreo' (Asturian-type barn).



b.

R.H.

c. Power station at Poncebos
in the Cares Gorge.



c.

R.H.

d. Houses in the village of Cain
in the Cares Gorge.



d.

R.H.

ened walls (no chimney), no furniture but rough stools and benches; the minimum of pots, pans, plates etc., for cooking and eating; the bedroom above, that is all. Presumably life has changed little here for centuries, except that the people's clothes and to some extent their pots and pans are factory-made articles purchased in the market, and their footwear also, a sort of thick rubber galoshes, resembling clogs in shape, no doubt more suited to wet mountain paths than the rope-soled 'alpargatas'. Though higher and wetter than Caín Bulnes is better off for pasture and hay meadows. Softer shaly rocks outcrop east of the village and give rise to an easy pass, Pandebaño, with good meadows on the slopes leading up to it; these slopes are still very steep and the meadows are dotted with barns where the hay is stored on the spot. Higher pastures in the hoyos are reached by difficult paths as from Caín. Shepherds stay up with the animals in the 'majadas' (huts on the high pastures) in the summer, and make Cabrales cheese (similar to Roquefort) from the milk of their cows, sheep and goats. The shepherds come down in the winter but the animals stay up there and they are visited daily, unless there is too much snow, when they are brought down to the village.

A third example of a very remote village is Sotres (3150 feet) which is situated on a shelf 550 feet above the river Duje; the river divides the Eastern from the Central Massif. Near the village are slopes sufficiently moderate for cultivation. The stream by the village plunges down a gully to the Duje and on either side of it are steep hayfields and pastures. There is no valley floor and equally steep meadows rise on the west of the Duje; in the bottom of the valley is a group of barns and cattle sheds. The Duje valley, though deep and narrow, is not so gorge-like as the Cares, and at its head lie the extensive pastures on the broad saddle of Aliva. In the summer the shepherds live in cages here at the southern end of the valley. The only flat area in the valley is at the Vegas de Sotres where there are small meadows divided by stone walls and barns, also some caves handy for maturing the cheese. Another area of good pasture pertaining to Sotres is a wide basin called the Jou de Traviellas (Plate VIb) on the east side of the pass of Pandebaño where there are several groups of stone huts which serve the triple purpose of haybarns, stables and quarters for

the shepherds. With these and other pastures higher up in the hoyos Sotres has considerable grazing resources. It is not only this however that makes Sotres a larger village than Bulnes or Cain; close by were zinc mines, now closed, which stimulated the growth of the village in the nineteenth century and led to the improvement of its communications with the outer world, a decent mule track being constructed leading down to the Deva valley.

Zinc mining also made more accessible the plateau of Aliva; this pass provides the easiest crossing of the range and is altogether a focal point in the region. The mines have disappeared but the hunting lodge of Alfonso XIII still stands (Plate VI) (the quarry is the 'rebeco', the local variety of chamois) and near it the State Tourist Department have built a mountain hotel which is well frequented by hunters and climbers and other less energetic holidaymakers during the summer months. They supplement the normal seasonal population of shepherds.

Turning now to the Deva valley, the upper basin, the Liébana, is a much richer and more densely populated area than Valdeón; the only route to the main road and railway along the coast lies through the Deva gorge but this is less fierce than the Cares gorge, although sufficiently spectacular, and there is a good road through it which runs right up the valley to Espinama, below the Pass of Aliva. There are also roads across the Cantabrian passes to Portilla de la Reina and Piedras Luegas. These better communications mitigate its isolation in modern times.

The basin is sheltered by the Picos from the damp Atlantic weather which frequently wraps the other side of the range in cloud and makes green any spot where plants can get a foothold on the rocky slopes. Liébana is much warmer and drier; it is warm enough for peaches and vines to be grown and the slopes are clothed with a maquis type of vegetation. There is a marked contrast in appearance between this 'Mediterranean' landscape and the green meadows of the coastal area only a few miles away. The basin is considerably dissected, giving slopes facing in all directions; the cultivated areas are scattered, steeper slopes being left in scrub. The influence of exposure is evident; for instance going south from Potes one has an impression of uncultivated maquis-clad slopes; returning northwards along the same route

PLATE VI
PICOS DE EUROPA



a.

R.H.

- a. Gorge of the River Cares.
The new path can be seen half way up on the left-hand side.

- b. Jou de Traviellas. Pastures with temporary dwellings. Sotres is hidden by cloud.



b.

R.H.

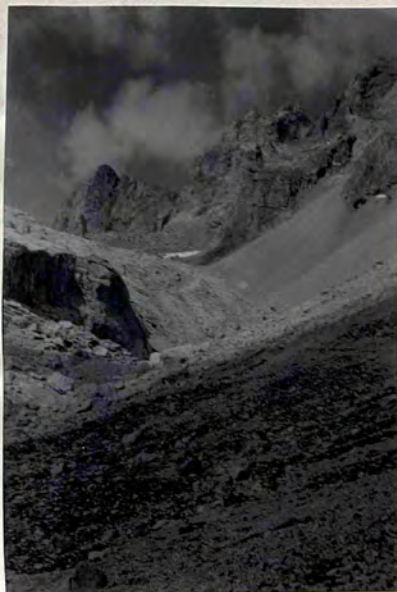
- c. Pena Vieja (8,579ft). The pastures of Aliva in the foreground are about 4,000ft.



c.

R.H.

- d. Part of a 'hoyo'.



d.

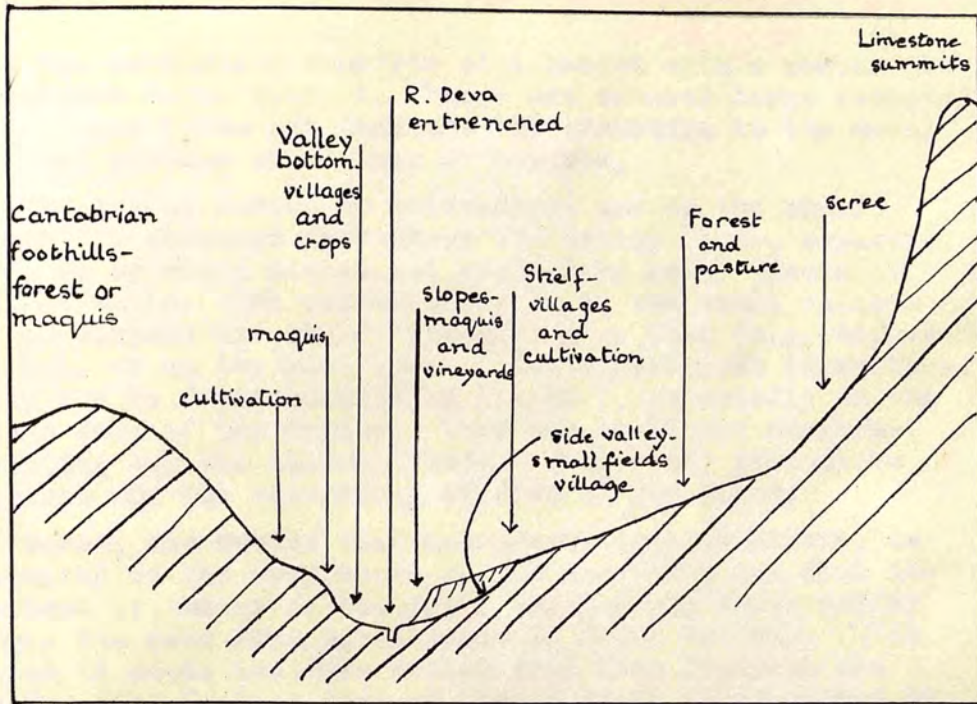
R.H.

the cultivated fields on the south side of each spur are seen.

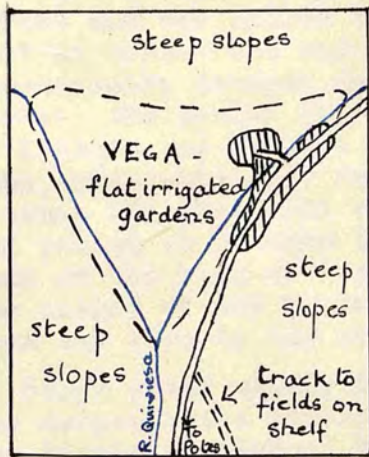
To make clear the distribution of settlement it is necessary first to discuss the transverse profile of the valleys. The river Deva and its main tributaries are entrenched 50 to 100 feet below a narrow fairly flat terrace which is almost entirely cultivated. This terrace is not continuous; it is particularly prominent near Potes. Above it rise steep slopes covered with shrubs and occasional fields and vineyards. Above these is a broad sloping shelf (Plate VIIc), very much dissected and partly maquis-covered but with areas of gentle and regular slopes where there is much cultivation. Some of the gullies which cut up the lower slopes have small fields in their upper parts. Beyond the shelf are forested hills with pasture; on the Cantabrian side these form the summits but on the northwest the scree and cliffs of the Andara massif of the Picos de Europa rise abruptly above them, marking the change to Carboniferous limestone at 1,400 to 1,500 metres.

Corresponding with the physical features there are two series of settlements (Figure 8). The lower lies on the valley floor, on the terrace immediately above the river, or more often on the slopes just above since the terrace is important for the cultivation of cereals. Potes, Cosgaya, Vega de Liébana, Valmeo, Frama, Ojedo, Cabezon de Liébana belong to this series. Frama, for instance, lies where a wide swing of the river gives gentler slopes; the village climbs up each side of the river, the newer houses being nearest to the highway from Potes to Piedras Luengas (the old road runs along the other side of the river). Valmeo likewise has a part each side of the river, one hamlet being by the road, the other climbing the side of a ravine across the river. It is very typical of these villages that they are composed of a pair of hamlets, on either side of the river, or at different levels (compare Caín, Bulnes, in the Picos valleys).

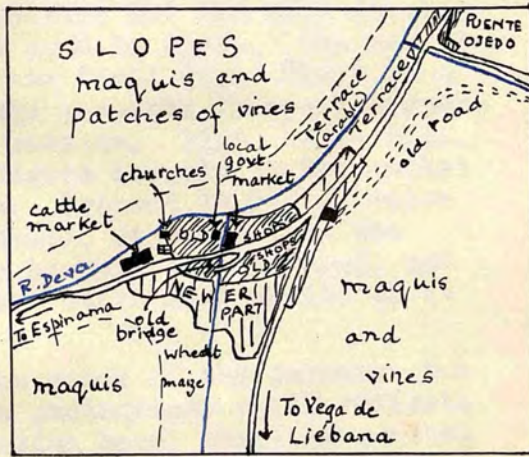
La Vega de Liebana (Figure 8), as its name suggests, is situated where there is a level irrigable area at the confluence of two streams. Having more room, the houses (whose larger size and better appearance suggest greater prosperity than the smaller villages) are spread out along the road. Cabezon de Liebana in the neighbouring valley is in an unusually wide open section of the valley



Sketch section of Deva valley near Potes to illustrate relationship between valley form and settlement.



Confluence site of La Vega de Liébana



Site of Potes.

Figure 8.

and the settlement consists of a hamlet with a number of scattered farms near it. There are several large isolated farms near Potes but they are the exception to the usual compact village or cluster of hamlets.

The second series of settlements are on the shelf, roughly a thousand feet above the valley floor, separated from it by steep slopes and reached by rough tracks or bridle paths. The villages may be in the small valleys which dissect the shelf, straggling up them (e.g. Argüebañes, Tollo), or on the platforms of the interfluves (Brez, Tudes). They can be distinguished on Figure 7, especially on the north side of the valley. They are small but numerous, bringing out the contrast between the sunny productive Liébana and the restricted defiles of the Picos.

Potes, the market town and administrative centre, is situated at the confluence of the Quiviesa, the most important tributary of the upper Deva, along whose valley comes the road from Portilla de la Reina in León. At Potes it meets the Deva valley road from Espinama and half a mile farther down at Puente Ojedo it is joined by the road from Piedras Luengas coming down the other main tributary valley. The major settlement might equally well have developed at either junction. The oldest part of the town lies near the old and new bridges over the Quiviesa; the town is spreading out along the roads. The new cattle market and new church lie upstream but the main development is downstream along the road to Ojedo. The town was considerably damaged during the Civil War. There is a weekly market; the autumn fair brings peasants from all corners of Liébana and dealers from outside. Pigs, hens, eggs, hams, vegetables and fruit figure largely in the market produce and above all cheese. Wrapped in plane leaves and packed in bracken in baskets, it comes into the town on the back of a donkey or on a woman's head, and the corner of the market where it is sold smells of it from one week to the next.

Shops cater mainly for the needs of the farmers, but the draper has a sideline in photography which reflects the tourist influence developing here; there is a hotel run by the State Tourist Department and those bound for Aliva must pass through Potes, and a visit here forms one of the major excursions from Santander. Motor traffic is slight; oxcarts, horses and the ubiquitous donkey are more usual forms of transport. Two buses each day connect with the railway at Unquera, which makes it quite well off for public transport by the standards of a small

PLATE VII
PICOS DE EUROPA



a.

R.H.

a. Potes. The autumn cattle fair. The large building is the new church.

b. A threshing floor near Potes. Andara Massif in the background.



b.

R.H.



c.

R.H.

c. Part of the shelf in the Quiviesa valley S. of Potes. Cantabrian summits in the background.

Spanish town. Other 'fondas' and a variety of eating places give evidence of its character as a meeting place and market.

As mentioned above the Deva gorge is followed by a road, but it is devoid of settlement for the greater part of its length. The most important village is La Hermida, the site of thermal springs. This village, as isolated as those of the Cares gorge before the nineteenth century, gained by the construction of the road to Potes and by the traffic to and from the Andara zinc mine, and, later on, from the tourist traffic made possible by the existence of the road. From Urdón, farther down the gorge, a track goes up to another very remote village, Tresviso, well known for its cheese.

The predominating factors influencing settlement in the area as a whole are the degree of slope and the character of the terrain. In the latitude of the north of Spain the altitudes found here (up to 7,000 feet) are not sufficient to preclude settlement, but there are such extensive areas of bare rock and steep, together with lack of surface water, that human occupation and agriculture can find little foothold in the limestone areas and are practically restricted to the sandstones and shales of the Valdeón and Liébana basins, both of which are in addition sheltered by the high mountains to the north. In much of the Picos only the surefooted 'rebeco' thrives. It is not hard to see the physical reason why in the eighth century the fugitive Christians took refuge behind these mountains and why Covadonga on their north west flanks was the cradle of the new Spanish kingdom; the starting point for the Reconquest of Spain from the Moors.

THE HIGH MOUNTAINS OF ASIA

HUNZA VALLEY FARMERS IN THE KARAKORAM

The Karakoram, lying to the leeward of the Western Himalayas, have a low rainfall and are for the most part barren. The valleys are deep gorges and the few roads are mere scratches along crumbling cliffs. Most habitations are on shelves some hundreds of feet above the river. This is true of the settlements of the Burusho people of Hunza who live in an 8 or 9 mile strip along

the Hunza valley (Figure 9) at a height of 6,000 to 8,000 feet. Aliabad, for instance, at 7,600 feet, is 500 feet above the river, a village of cube-like stone houses, the interior having no more than a hearth, sleeping platforms and a store cupboard (the people live and sleep out of doors in the summer). The living room is entered through the byre; the animals' warmth helps to heat the house in winter, when there are 6 to 8 weeks of severe cold. The fields are painstakingly made by carrying earth and building supporting walls; they are small strips about 3 feet wide and 10 or 12 feet long, with a tiny ditch for water. The water comes from the Rakoposhi glacier. The use of the water is carefully regulated and the farmers build small reservoirs among their fields to store the water if they do not want to use it immediately when it is their turn for supply. With the glacier water and the high temperatures and strong insolation of summer the Burusho are able to harvest 2 crops a year. Barley is planted first, and harvested in June, or wheat, which is ready in July; then millet or buckwheat is grown and harvested in October. Lucerne, potatoes, melons and tomatoes are grown, also fruit trees, of which the most important is the apricot, which figures largely in the people's diet (sugar and oil); they are unwilling to go and live in higher but better watered valleys where this fruit will not grow. Their vines produce a little wine. On the steeper ground above the 'bay' of Aliabad there are upper channels which irrigate 'gardens' of trees (willow and poplar) and some strips of grass which are used for grazing. In autumn these meadows are carefully cut, even swept, to get all the plants, and the leaves of the trees are collected for winter fodder. Even then there is scarcely enough and in the spring the poplars are stripped as soon as they are in leaf to give food to the cattle, sheep and goats (the usual peasant household has about 20 animals).

Settlement originally was in fortified villages because of the danger of attack but with British control of the area this decreased and they began to build out in their fields. Although an important road from Kashmir to Central Asia passes through the valley the people take little part in trade; they have no surplus of marketable produce. Their implements are mostly wooden and homemade. There are a few specialist craftsmen, carpenters, weavers, millers. Sometimes sons of the household will emigrate to India to find work, since the resources of the valley are severely limited.

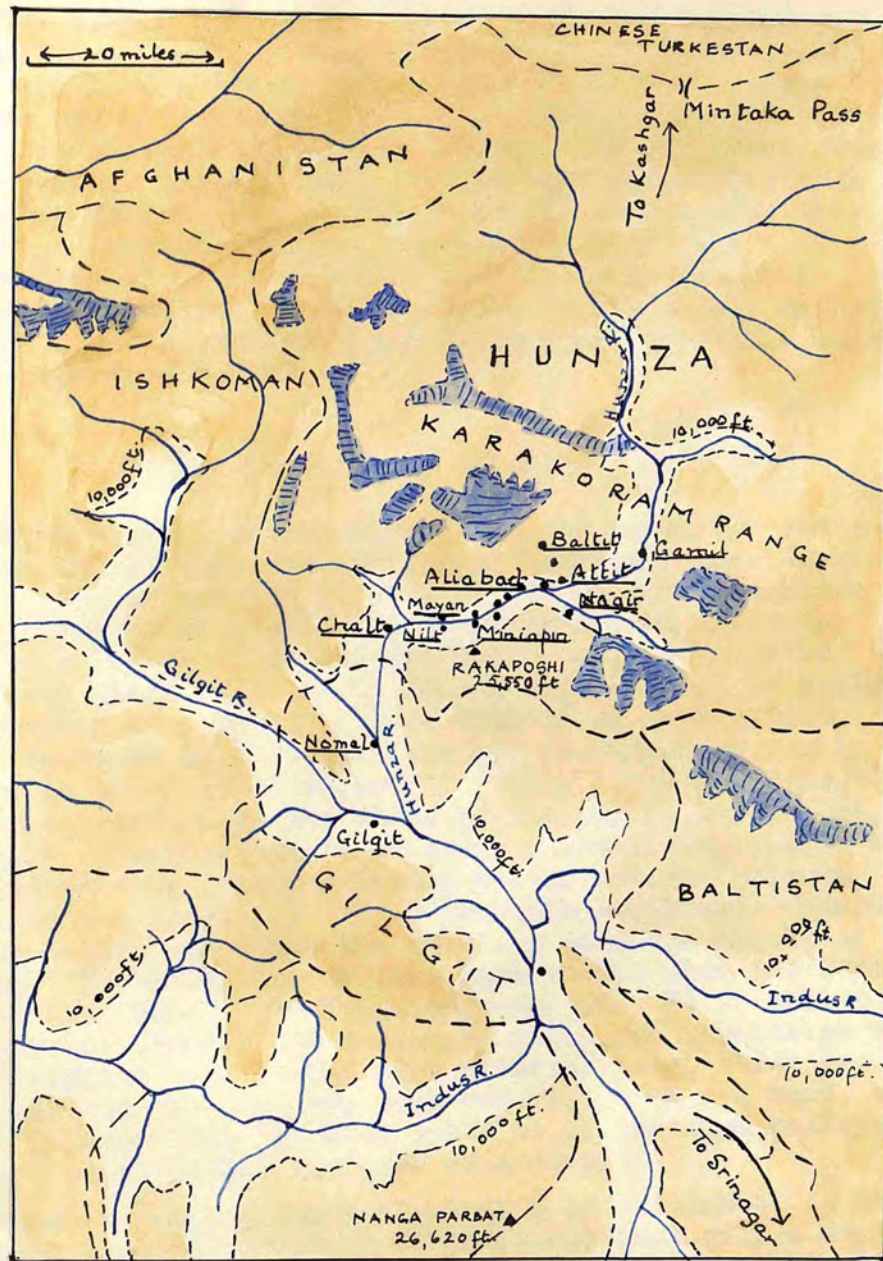


Figure 9. Hunza Valley in the Karakoram.

The higher reaches of the valley above Baltit, the capital, are mainly settled by Wakhis from Afghanistan; there are good pastures there and barley will ripen; they do not miss the wheat and apricots which will not ripen, and without which the *Burus* will not live. The Yasin valley, farther west, is much better watered than the Hunza valley, but higher, with longer and more severe winters. They cannot grow two crops a year, but they have a surplus of wheat which they trade at Gilgit for tea and sugar, luxuries which the Hunza people cannot afford. The settlements of these high valleys are veritable oases in the mountain wastes.

THE ALTIPLANO OF BOLIVIA

Isaiah Bowman, in the Andean studies which are interpolated in the American edition of Brunhes' Human Geography, gives an account of part of the Bolivian highland which consists of a broad basin between high plateaus. This is a region of inland drainage where the outflow from Lake Poopo finishes in swamps and salars. As would be expected in a basin of this type in an arid climate it is bordered by alluvial fans and its floor is partly buried in accumulated sediment. While irrigated agriculture is carried on at the edges of the basin, the slight rainfall is sufficient to maintain a scanty vegetation and this extends up into the rather better watered heights right to the snowline. It is possible everywhere except in the salars and above the snowline to graze flocks of llamas. The existence of this pasture has made the Indian farmer half nomad - half agriculturalist. He is able to produce for himself the necessary grain and vegetables in his irrigated land on the rich alluvial fans, which are fully occupied and also to have wool and meat from his herd, with which he seeks out the best pastures in the high valleys, often a considerable distance from home.

Bowman describes the distribution of settlement in the highland east of Oruro - " Above 14,000 feet only a most desolate landscape appears, with low scattered bushes and bleak windswept highlands. Then come valleys where, at about 12,000 feet and in the well-watered patches, barley fields of some consequence appear. At one spot we observed a shaded spring, frozen solid, and just above it on a sunny slope a patch of growing barley. A greater abundance of natural vegetation is noted here, with a

corresponding increase in the number and size of the flocks of llamas and sheep. At 11,000 feet occur a few potato fields and lower still in succession one sees blossoming orchards and vineyards, thrifty vegetable gardens, masses of violets, hyacinths, sweet peas, and laden orange trees. Throughout the whole descent one sees at every turn the barley fields on the alluvial fans tributary to the main valley. The gradation in the size of the villages is as regular and certain as the downstream increase in the sizes of the alluvial fans". (11)

Bowman emphasises the constancy of the water supply on the piedmont strip and also the importance of mining towns as a market for barley, vegetables, meat and blankets. He contrasts this area with the mountains in North Chile rising from the Atacama Desert where the population is split into two groups, the sedentary oasis dwellers and the nomadic shepherds. There the population cannot vary their resources by combining the role of pastoralist and cultivator because of the lack of adequate pastures accessible to the oases.

A further contrast is apparent on the eastern slopes of the Andes where the rising winds give a belt of greater precipitation which permits a growth of forest between 4,500 and 6,000 feet. Below the forest there is irrigated agriculture; in the forest agriculture and grazing are combined; above the forest are grasslands with a population of shepherds. Trade takes place between these zones and the nitrate mining areas of Chile; this is discussed in section III.

(11) Bowman, op. cit. p. 496.

SECTION II

MINING AND OTHER INDUSTRIAL SETTLEMENT

Whereas agricultural settlements occur scattered about in most mountain areas, mining settlements are usually restricted to special localities though most mountain systems can provide examples of some kind of mining activity. This kind of settlement has two main characteristics. The first is that the population has ignored the usual controls of settlement which have already been discussed in relation to agriculture, for in this case they do not necessarily depend on local food supplies. Even water may be brought considerable distances if the value of the minerals is sufficient. Mining villages are found at great heights in the Andes and in extremely arid areas. The second feature is their transitory nature for when the mineral resources are exhausted or if the economic situation causes mining to cease because of transport costs preventing successful competition with other areas the settlements decay and may die out altogether. North America has many 'ghost' towns especially where gold or silver was mined.

The mineral wealth of mountain areas usually consists of non-ferrous metals. The chief economic minerals, coal, iron and oil, occur mainly in sedimentary rocks which have not been affected by major earth movements; mountains with their history of folding, faulting, igneous intrusions and vulcanism are richer in gold, silver, copper, lead, zinc, etc.

For instances of settlements arising from mining activities one may look chiefly to Europe and the Americas. In Africa and Australia mining is not carried on in truly mountainous areas. Asia does not provide any outstanding examples of mineral wealth affecting settlement because of the general lack of economic development and transport and the inaccessibility of her mountain areas.

In Europe the most significant case of the development of mining settlements is seen in the Hercynian horsts north of the Alpine folds. The Thuringer Wald (iron and copper) and the Harz Mountains (silver, copper) in Germany, the Lysogory in Poland, and, farther east, unrelated structurally but very similar in its geology and landforms, the Ural Mountains (gold, copper, tin, platinum) all have settlements resulting from the exploitation of their mineral wealth. In the West Carpathians the Spiš Ore Mountains, which are composed of Palaeozoic schists with

volcanic intrusions, were settled in the Middle Ages by German iron miners, though the iron industry is now only of historical interest. The same is true of the mines of the Thuringer Wald and the Harz but the population has turned to manufacturing industries such as fine metallurgical work, and the making of medical glassware and porcelain so that these heights are fairly well occupied despite their unfavourable conditions with thick forests and poor soil. (see page 50).

The high latitude of Scandinavia renders most of the mountains of Norway and Sweden out of the question for settlement based on local agriculture. Mining settlement is scanty; there is some in Norway (e.g. copper mining at Roros, made accessible by the railway through the Glommen valley; copper and pyrites at Sulitelma). More notable are the iron mining settlements of Sweden, Kirunaavaara and Gellivara, within the Arctic Circle where the rich magnetite appears in hill ranges owing to its resistant character. It is expensive to maintain workers in such an unfavourable situation and the ceasing of mining would mean the abandonment of these settlements which are artificial in character.

In the Alpine mountain system of Southern Europe mining is relatively less prominent as an influence on settlement but it is important in certain areas. One example is to be found in the valleys of Asturias where the presence of coal has increased population (though this area might be compared with the Hercynian series, since the Cantabrians were already folded in Hercynian times). This is a live industry; the nearly zinc mining of the Picos de Europa is dead, leaving no traces except for the increased size of the village of Sotres and better communications for the Deva valley. Farther east in Vizcaya the iron ore of Bilbao has helped to stimulate the numerous small industrial towns cramped in the narrow valleys of this less rugged part of the Cantabrians. The valley of the river Deva (not to be confused with the river of that name in Santander province, mentioned in connection with the Picos de Europa) is particularly remarkable for its very old-established metallurgical industry, mainly concerned with the making of small arms; Eibar is particularly outstanding; other towns of this narrow winding valley are Elgoibar, Ermua, Placencia, Vergara, Mondragon. The Alps themselves have little mining settlement except in the east in Styria; this will be dealt with in more detail below.

In North America, where, as mentioned above population pressure has not driven people to occupy the highlands

to any great extent, the influence of mining is more apparent, especially in the Western Cordillera; indeed this type of settlement has generally preceded agricultural settlement and its special characteristics are more clearly to be seen. There are important mining districts for nonferrous metals in the Northern Rockies, in British Columbia, Montana and Idaho; in the Central Rockies in Colorado; in the Wasatch Range south of Salt Lake City, in Arizona and in the plateau country of Nevada, and in the Northern and Central Sierras of California. One of the most important centres is Butte, Montana, originally famous for silver, but now the leading copper producing district in the U.S.A. Helena, also in Montana, has had a different history. Originally a centre of gold mining this activity has declined, but Helena has found a new function as the capital and route centre of a mining district; also it lies in the irrigated and intensively farmed Gallatin valley. Not all centres whose mining decays continue to flourish. Helena was well situated agriculturally and commercially but many small mining centres with no secondary resources have been abandoned altogether. Mining has played a particularly important part in the development of Colorado, whose intricate mountain system contains zinc, silver, lead and gold ores. These have led to the growth of such cities as Denver, Pueblo and Leadville and to the development of railways, despite the difficult nature of the country. As a result of this economic opening up to the state irrigated cultivation of alfalfa, potatoes, beet and other crops developed to such an extent that now only California has a larger area under irrigated crops the Colorado. In British Columbia likewise 'gold rushes' stimulated the development of transport, which in its turn has stimulated mining (i.e. the Crowsnest Pass, coalmining for the railway).

In the Central U.S.A. the Ozark-Ouachita region has some mining settlement exploiting zinc, lead, manganese, barite and sand (for glassmaking) but this area remains backward and isolated since it is unfavourable for cultivation so that there is little to stabilise and perpetuate the occupation resulting from its mineral wealth.

In the Appalachians the situation is unusual in that the governing mineral is coal, more usually associated with lowland settlement. The anthracite field lies in the Great Valley region, the bituminous coalfields of Pittsburgh and West Virginia lie on the Allegheny Plateau. Here the rivers have excavated deep narrow valleys, and the mining villages and towns are confined in these.

Often there are terraces as a result of rejuvenation, e.g. in the Youghiogheny and Monongahela Valleys which not only provide suitable sites for settlements (e.g. Connellsville on the Youghiogheny) but facilitated the construction of railways. These valleys suffer the same social disadvantage as those of the South Wales coal field, that of isolation one from the other, a physical restriction on the miner's outlook and life.

In Spanish America the development of European settlement has been associated with mineral exploitation from its initiation in the sixteenth century by the Conquistadores. In Mexico flourishing cities developed such as Guanajuato, Zacatecas and San Luis Potosi in the high intermont basins; Zacatecas lies at 8,005 feet; it has declined in wealth and population, the common fate of mining cities.

Gold and silver led the Spaniards to the Andes but today copper is the mineral of greatest importance. The folded sedimentary rocks of these ranges have been much intruded by igneous rocks, diorites, andesites and porphyrites, and this has resulted in extensive mineralisation. Where volcanic deposits exist they may mask the mineral veins, but they provide their own contribution in the form of sulphur and borax. Owing to transport difficulties and the arid conditions of many of the richer areas there is in general concentration on large scale operations in areas within reach of railways. The most important areas are in the Western Andes in Southern Peru, and the Bolivian departments of La Paz, Oruro, and Potosi in the Eastern Cordillera, the latter being very rich in tin and silver. A third region is in the Western Cordillera behind the nitrate zone in Chile. Many of the richest deposits occur at greatest heights; mines exist at over 16,000 ft., even at 17,500 feet in the Sierra de Chorolque. It has been mentioned already how mineral production has stimulated agriculture in some Bolivian districts by providing a local market. This is quite a different case from the development in Colorado where the market for the products of the state's irrigated cultivation is nation-wide and so on a basis now independent of local mining.

Apart from mining industries which provided the whole or part of the 'raison d'être' of certain settlements, small industries, sometimes carried on in the home, have in the past helped to keep more people in the mountains than agriculture alone could provide for. These were usually based on some local raw material; flax or wool led to textile industries (Sudeten Mts., eastern valleys of Switzerland and the Vorarlberg); animal skins were

available for leather working (glovemaking in the mountains round Grenoble). The abundance of wood in the forests led to charcoal burning, and sometimes metal industries associated with it, e.g. nail-making in the Bauges Pre-Alps. Such industries once established might draw on raw materials from outside the region, iron to the Bauges, or Spanish wool to the French Pre-Alps. An industry needing little raw material but much skill is the best for avoiding the heavy burden of transport costs, such an industry is clockmaking, to be found on both a large and small scale in the Jura Mountains.

Many of these industries are now of historical interest only because in modern times they have tended to move down the valleys and out of the mountains to large scale production in factories, and their special characters as mountain industries has been lost. Their decline has helped to depopulate the areas where they were carried on.

At the same time another type of industry has brought the mountains into their own again; that is to say, hydro-electricity. For the development of this power it is necessary to have a sufficient volume of water with a considerable velocity resulting from either the force of gravity of a large and continuous supply of water farther up the river. While it is true that large schemes exist outside highland areas (Niagara, Dneiprostroy) and others are planned (the Stalin plan for the Dneiper, Don, Volga, Amu Darya and other rivers) present and future hydro-electric power is and will continue to be developed in mountain areas for they provide the most favourable physical and climatic conditions.

Heavy rainfall is essential and the climatic conditions must be such that the rainfall is available for use and the supply evenly distributed throughout the year. For instance with great heat much may be lost by evaporation. Sharp seasonal differences in volume make it difficult to run power stations continuously and economically. Glaciated mountains have a great advantage in that the permanent snow and glaciers regulate the supply of water, and their melting may increase the supply just when evaporation, and in some climates, lack of rainfall, would reduce it. Otherwise the building of artificial reservoirs is necessary to regulate the supply.

The physical features of glaciated mountains are also the most advantageous. Glaciated valleys are typically ungraded; they tend to consist of a series of basins cut off from each other by 'verrous' or 'riegels', rock steps through which the river may have cut a gorge. Besides the opportunity provided by the fall at these points, the

tributary valleys are frequently 'hanging', the fall to the main valley has often been used (see below, the account of the French Alps). The glacial lakes, whether in cwms or the main valley, provide natural reservoirs; if there are no lakes, the glacial troughs are suitable for constructing artificial ones. Finally the broad glacial troughs provide room for the development of railways and factories. Gorges which provide good sites for dams may be an obstacle to further industrial development.

The extent to which hydro-electric power schemes affect settlement depends on whether the power is used locally or supplies the plains adjacent to the mountains. If local industries are to be established, there must be good communications, for raw materials will almost certainly have to be imported, and certainly the products will need to be exported from the locality. The type of industry is frequently one which requires specifically electric power e.g. electrometallurgy, electro-chemical processes, or aluminium smelting, which requires high temperatures which only electric power can produce. Textile industries may be already in existence, with a present or past basis of local raw material. Another factor of importance is the existence of a supply of labour; once the industry is established it may attract labour from elsewhere, but it is more rare for it to be established in an empty area where special settlements have to be built. Examples of how the factors dealt with above have operated in a particular area are given below in the section on the French Alps. Large-scale schemes for the future there as in other areas adjacent to well-populated lowlands are largely concerned with the production of power for the lowlands rather than for the mountains themselves, though some local industries will be established and improved transport and other amenities are likely to follow their development. Such are the Eytherma and Enytrac schemes for the French Massif Central and the Emalp scheme for the Western Alps; the latter is international in scope, involving France, Italy and Switzerland. These countries already have important hydro-electric establishments and so has the fourth Alpine country, Austria, though to a lesser extent than her western neighbours.

Of other European ranges, the Pyrenees are the most comparable with the Alps. The Eastern Pyrenees, like the southern French alps suffer from the Mediterranean summer drought, and the range as a whole lacks the extensive snow

and icefields of the Alps. But the Central section has heavy winter snowfall, and the Western Pyrenees are within the moist Atlantic influence. It is these two latter sections where possible sites have been utilised, below the Cirque de Gavarnie, and in the Adour, Garonne and Ariège valleys. The French side has the advantage of being the steeper and wetter side of the range; Spanish development is mainly concerned with the Catalonian industries in and around Barcelona.

The mountains of Scandinavia are very different from the Alpine ranges in that they consist of a high denuded peneplain, little dissected in its higher parts, though with some residual peaks of more Alpine form. The margins of the fjelds, however, are cut into by the deep glaciated valleys of the fjords. These valleys provide good sites for the development of power which is used both in Norway and Sweden for the lumbering and other industries. In Norway aluminium smelting is particularly prominent (Odde, Tyssedal), and there are nitrate factories at Notodden and Rynkan in Telemark. Though physical features are favourable for water power development, they are not so favourable for communications, and these valleys are more isolated than those of the Alps where communications are exceptionally well developed for a mountain area. Also owing to the higher latitude little agriculture is possible and the mountains are very scantily populated. In the British Isles the mountains of Scotland and Wales are similar in character to those in Scandinavia though very much lower. Consequently in order to produce a substantial head of water a number of valleys and lakes must be linked as they are for the Kinlochleven power station. The chief industry supplied is the smelting of aluminium, carried on at Kinlochleven, Fort William, Foyers and Dolgarrog (the last named in North Wales). This industry is significant as a source of employment in the Scottish Highlands which have few economic resources.

In North America control of rivers has been concerned primarily with flood control and irrigation but the building of a dam has usually involved the construction of a generating station as well, and if not, the facilities are there for its creation in the future. The Tennessee Valley Authority, concerned with the co-ordination of all the resources of the valley, has naturally paid attention to the development of power. Its series of dams, controlling the river to prevent flooding and improve navigation, also harness the power, bringing heat and light and power for local industries into what was

previously a very poor mountain area. Of all the states California has the most developed power. The snow-capped and glaciated Sierra Nevada provides water for both irrigation and power, but the power is serving the valleys rather than the mountains. Farther north the Grand Coulee Dam and its future ramifications will provide a great deal of power which could be used by settlements in that area. British Columbia, with heavy rainfall on high glaciated ranges has ample power resources that are scarcely touched. The major comment to be made of all the Western Cordillera is that power resources offer great possibilities and there are plans to put them into effect but at present the mountains await the populations to employ them.

In South America as a whole the Andes have few possibilities. Except in the extreme north and south they are too dry; the tropical forest areas of the north are very badly served by communications and are not favourable topographically or in their rainfall regime. In the south the Andes of Argentina and Chile have more to offer especially in the wetter south. But the poor communications, lack of population and low stage of general economic development militate against much use of power for a long time to come. Liability to earthquakes is another disadvantage.

Africa's possibilities arise from the general condition in that continent that rivers rise on the plateau and have a sharp drop to the coastal plain. The variability of rainfall is a very serious drawback and at present the lack of economic development puts hydro-electric power out of the picture except in the south where development might take place in the Union of South Africa. Here too the rim of the plateau has its most mountainous aspect in the Drakensberg. But it is a question for the future, not a matter of present-day settlement. For the most part the same can be said of Asia; at the present time there is not the industrial development, except in Manchuria and Japan. Australia has sufficient rainfall only in the south-east, where power production can be linked with irrigation schemes as in America. New Zealand has plenty of rainfall and glaciated mountains, but also only a small population and an agricultural economy; perhaps the future will see developments there which will affect settlement.

This brief survey of the continents brings out the fact that the state of general economic development, the density of population and the existence or non-existence of adequate communications are of supreme importance in determining the extent of hydro-electric power develop-

ment. Climatic and physical potentialities remain dormant unless these human and economic factors are operative. Thus it is in Europe with its dense population, high degree of industrialisation and close relationships between neighbouring highlands and lowlands that hydro-electric power can be seen to have influenced existing settlements, and to a lesser degree in the less densely populated United States. Meagre resources in such an area will have more effect than the enormous potential but unused power of an empty and backward area.

The following examples from North America and Europe illustrate the precarious existence of mining settlements (Silver Peak, Blair) unless backed up by other resources (the Black Hills of Dakota). The Styrian iron mining shows how mining increases mountain population, and the Harz Mountains show how mining can establish population which does continue to exist after the mining has died out. The Welsh slate quarrying has modified the type of settlement in Snowdonia. The French Alps provide the most highly developed example of the use of hydro-electric power and Jenbach gives an individual example of the old and new industries of a mountain town in the Eastern Alps.

SILVER PEAK AND BLAIR

MINING SETTLEMENTS IN NEVADA (12)

Mining settlements may grow up in places which are not only unattractive to settlement but definitely have no other possible basis for it. This has often happened in the more arid parts of the Western Cordillera in North America, for instance in Nevada. Silver Peak was founded in 1863 about 105 miles east of the Yosemite valley. The rich silver veins in Silver Peak Mountain 2 miles to the west decided the location of the settlement but its exact site is governed by water supply, where springs emerge below a butte. The surrounding area is semi-desert; no agriculture is possible, and the settlement, whose population is about 100, will last as long as the silver veins last (or rather, as long as their exploitation remains an economic proposition). After that it will die; there are many 'dead' mining towns in the Western United States. Three miles away from Silver Peak a town called Blair was founded by a mining company in 1907. A settlement for 500 people was built, and water piped from Silver Peak since there was no supply on the site. The mine only operated until 1917; then it

(12) Griffith Taylor. Urban Geography. London 1950. p. 302.

ceased and the town disappeared rapidly. Its conditions of growth were entirely artificial and so it lacked permanence; Silver Peak is a more stable settlement but it likewise lacks a real permanent basis for its existence.

THE BLACK HILLS OF DAKOTA (13)

The Black Hills of Dakota consist of an eroded dome which has given rise to a series of concentric zones within the upstanding rim of Dakota sandstone which bounds the mountains. Immediately inside the rim the erosion of softer shaly Triassic rocks has produced a continuous oval trench which encircles heights of Carboniferous limestone, and in the central basin Precambrian rocks wrap round a core of ancient granite. The Interior Basin in the central zone and the limestone plateau are covered with forests of Yellow Pine; the inner lowlands are grassland; the outer rim has woods of cottonwood and oak. In 1875 rich gold deposits were found in the centre near Custer and in the following year a gold rush brought 10,000 people into the region. Discovery of alluvial gold caused the majority to migrate to Deadwood, farther north. Settlements were founded both in the interior basin (inside the limestone rim) and in the Interior Lowland (inside the sandstone rim).

The whole region now has a population of 42,000 people, 29,000 of whom are in the towns, engaged in mining and commerce. The Triassic inner lowland has the greatest density (31 per sq. mile). There are four main occupations in the hills, mining, ranching, lumbering and catering for the tourist trade. The mining is most important in the central basin, in the southern granite area of Keystone and Custer, and farther north round Deadwood where it is associated with Tertiary intrusions. There is also lumbering carried on in this zone. The ranching is carried on in the Triassic lowland mainly on the major streams where alfalfa is grown with the aid of irrigation. There are smaller ranches in the clearings in the central pine forests. The largest town, Rapid City, lies in the ranching zone; it is connected with Chicago by rail. Thousands of visitors come, mainly by car, to the Custer State Park, the largest in the United States.

The mineral wealth gave birth to the first settlements and brought the railway (1891 to Deadwood, 1907 to Rapid City) which facilitated further settlement in these hills,

(13) Griffith Taylor. op. cit. p. 295 - 8.

whose height (7,000 feet) gives them a greater precipitation than the surrounding areas of the Great Plains. Their diversified relief and geology has combined with this to produce an area with greater variety of resources than the nearby plains, where there are extensive 'Badlands', and have made possible permanent settlement not dependent on exhaustible mineral resources.

IRON MINING IN STYRIA (14)

The Austrian province of Styria in the Eastern Alps would be a backward area if it were not for its mineral resources. The iron industry, once scattered in forested valleys, is now concentrated near lignite supplies. These are found in the Mur-Murz longitudinal valley, a wide open valley with the characteristic climate of these central European valleys, hot summers with sunny winters and late-lying snow. The valley has the advantage of forming an east-west routeway, connected with the Danube valley via the Semmering Pass and westwards by the Schober Pass with the Enns valley. German influence penetrated by both routes and large villages developed on the terraces. The richest iron ores lie at the foot of the Hochschwab at Eisenerz; others beyond the valley are at Liesen (Enns valley), at Sanalp, and at Schladming in the Radstätter Tauern; at the latter there is more copper and nickel than iron. When coal replaced charcoal for smelting the furnaces in the smaller valleys were abandoned. The big furnaces of the present day are at Eisenerz and near the lignite in the Mur-Murz valley and at Judenburg where there is coal. The relatively easy communications across the Semmering Pass facilitated connections with the Silesian industrial area, as did the pre-1919 political conditions in which both areas were under the rule of the Hapsburgs.

Leoben, Donawitz and Judenburg together form a considerable industrial agglomeration based on a steel industry whose location is governed by the presence of lignite and access to the railway. They are the most important of the towns whose growth the industry has stimulated, others are Fohnsdorf, a lignite centre, Knitterfeld with its railway workshops and metal industries, and Bruck on the route to Graz, with paper and metal industries.

(14) E. de Martonne. Central Europe (Geographie Universelle) Vol. IV Part 1. Paris 1930. p. 471 - 473.

THE HARZ MOUNTAINS (15)

The Harz Mountains in Central Germany are formed by a horst, about 56 miles by 18 and about 2,500 feet in height. Despite this low altitude it has a strong individuality as a result of its isolation amid lower land and the steep bounding scarps; these are highest in the northwest above the lead mining town of Goslar. The massif is mainly forested except on the very/exposed Brocken peak which rises to 3415 feet. The Harz were famous for their mineral wealth; silver ores were discovered in the tenth century and the mines grew rapidly in wealth during the eleventh century, especially in the Rammelsburg area near Goslar where gold, silver, lead, zinc and copper were mined. Mining has decreased in importance; Elbigerode is a centre of iron mining, and there are iron foundries on the railway linking Hasselfelde and Harzegeode, but the mining of Hasselfelde is only of historical interest now, and Harzegeode is a tourist town with chalybeate springs. The Bode valley profits from its picturesque scenery; there is a railway from Blankenburg at the base of the northern scarp. The Claustal once had 13,000 miners producing silver, lead and zinc, but now-a-days its output is small and the peasants are concerned with woodworking, cahrcoal burning, canary raising, and with stockrearing and primitive agriculture.

Thus Harz Mountains present plateau settlement based on mineral resources which have largely been worked out. The region was otherwise unfavourable to settlement and would not have attracted it had there not been mineral wealth. The population became well-established through centuries of mining activity and though that has now decreased or disappeared altogether the settlements remain, based now on the scenic attractions of the area which is near to the densely populated parts of the North German Plain.

SLATE QUARRYING IN NORTH WALES (16)

In Snowdonia the Caledonian earth movements compressed the Cambrian and Ordovician sediments into the slates now quarried or mined at Bethesda, Llanberis, the Nantlle

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- (15) Griffith Taylor. op. cit. p. 293 - 295
 (16) R. Scott. Snowdonia, London 1949. p.391 - 7.

valley and Blaenau Ffestiniog (Figure 10). The Penrhyn quarries near Bethesda were worked by part-time farmers till in the eighteenth century Lord Penrhyn bought out the quarrymen and embarked on the systematic exploitation of the quarries. The model village of Bethesda was constructed near the quarries. When the wars with France restricted the trade in slate Lord Penrhyn, unable to maintain the employment of his quarrymen, set them to draining and enclosing land near the quarries; this activity resulted in little settlements of crofts at about 750 feet. On the opposite side of Elidir Fawr, in the early years of the nineteenth century the Lord of the manor of Dinorwic similarly brought all the slate quarrying into his hands in one large scale enterprise. No model village was built here but the growth of Llanberis and Deiniolen is associated with the growth of the quarries.

About the same time quarries were started on the Ordovician slates of Blaenau Ffestiniog. These might more accurately be termed mines since instead of the great open face quarries of Penrhyn and Dinorwic the strata followed under the lower lying rocks by inclined tunnels into great chambers. In 1836 the narrow gauge railway to Port Madoc was opened, which was to become a pattern for narrow gauge mountain railways in other continents, notably in India and the United States. Horses were used at first but afterwards steam locomotives were introduced.

The heyday of the slate quarries was in the nineteenth century; between the world wars the slate villages not only felt the draught of the general economic depression but were affected by the change in building styles which reduced the demand for slates. However, though declining now the industry has left its mark in the larger concentrations of population and the terraces of miners' houses on the hillside in contrast to the scattered sheep farms and hamlets of the agricultural population. Wales has its 'dead' mines too, for example the ruined copper mines on the shores of Llyn Llydaw and Glasllyn of Snowdon. Beside these the pipeline snaking down to Cwm Dyli power station is a reminder that these mountains, low as they are, have hydro-electric power possibilities. This does not affect settlement though, since it does not stimulate local industries (with the exception of the aluminium plant at Dolgarrog in the Conway valley).

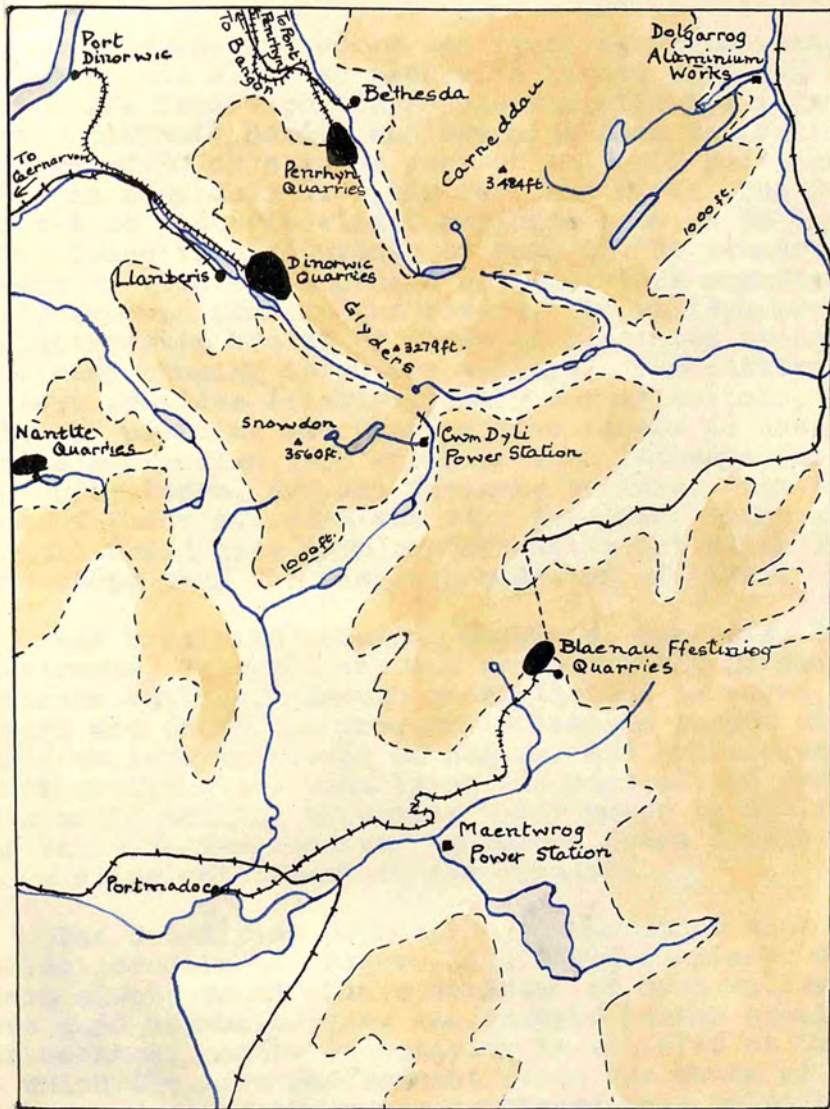


Figure 10. Slate Quarries and Hydro-electric Power in Snowdonia.

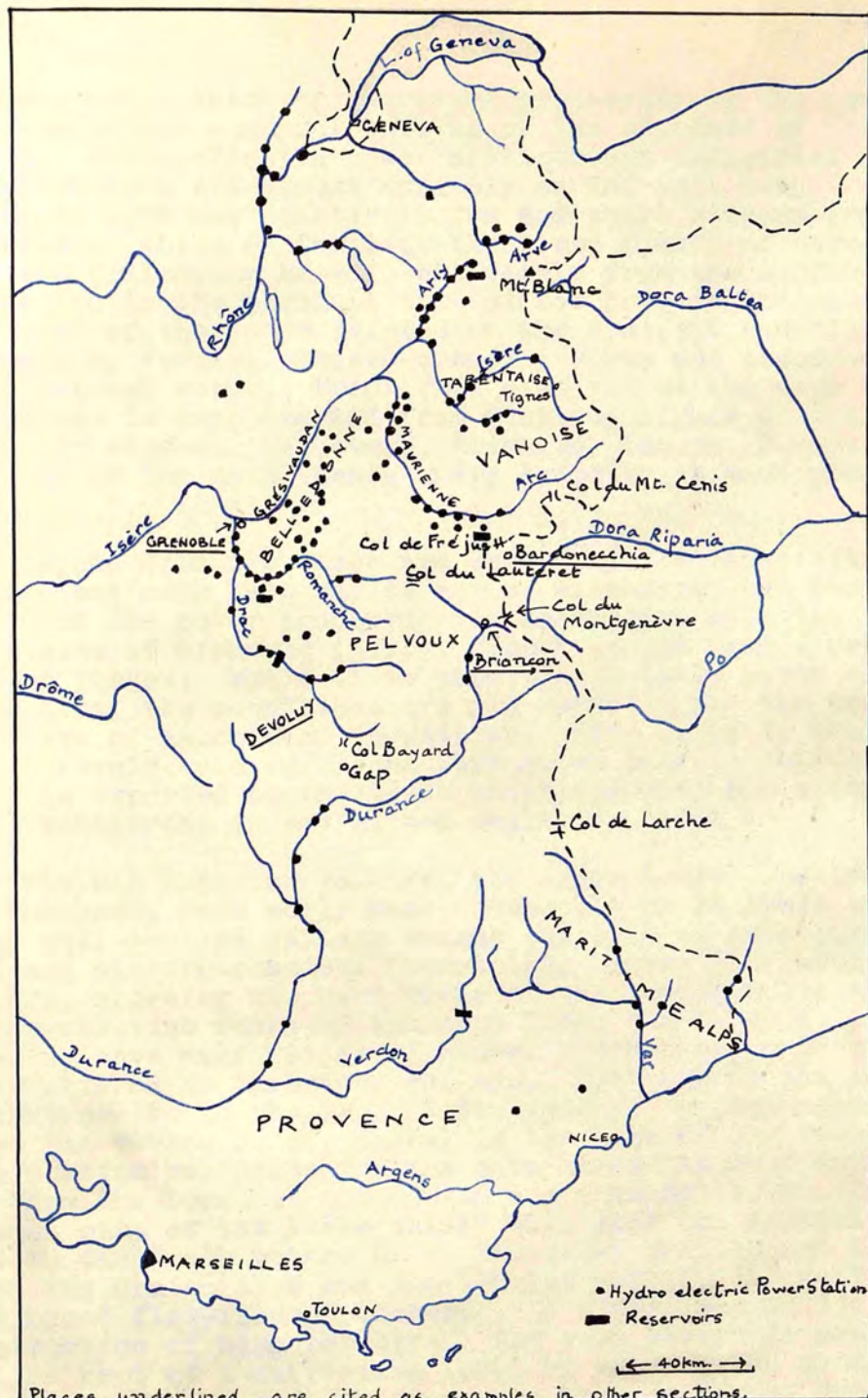
THE NORTHERN FRENCH ALPS
HYDRO-ELECTRIC POWER DEVELOPMENTS.

Hydro-electric power was first developed extensively in the French Alps, an area with little coal and very favourable from a physiographic and climatic point of view. In Haute Savoie and Dauphiné snow may fall on an average of 30 days in the year up to 3,000 feet, and on twice as many days at 6,000 feet and more. The Prealps, exposed to westerly winds, may have snow on 50 days in the year. There is also plenty of rain in the summer and the action of glaciers and névé as regulators ensures a relatively even flow in the rivers. The valleys present the characteristic breaks of slope of glaciated troughs and have many hanging tributary valleys. The pattern of the valleys provides relatively easy communications, since the 'cluses' piercing the Prealps give access to the Sub-Alpine Depression from which in turn railways run up the upper Isere, Arc and Romanche valleys. The development of these railways was very important since without them it would have been impossible to establish industries other than the simple production of power.

The Prealpine massifs, Chablais, Genevois, Bauges, Chartreuse, Vercors, are not as favourably placed as the interior valleys. Though precipitation is heavy, the rivers are short and frequently deep in gorges which make their valleys difficult of access, and hydro-electric power stations are usually on the edge of the massif and on a small scale, exporting their power to the surrounding valleys. The industry therefore plays little part in stimulating settlement in the Prealps.

The Sub-Alpine Depression on the other hand has excellent conditions (Figure 11). There is plenty of water; steep slopes bound this succession of open valleys which have good communications and an ample labour supply. The northernmost centre of activity is situated at the gorges by which the Arve and Bonnant reach the basin of Sallanches. Some of the power developed here helps to supplement that of the stations in the Arly valley, the lower part of which, between Ugine and Albertville, forms the next industrial concentration (mainly electro-metallurgical).

The Arly flows into the middle Isere valley which leads south into the great trough of Gresivaudan, the busiest of the Alpine valleys where the development of industry



Information on H.E.P. stations from Geog. Journal Sept. 1951.
 A.F.A. Multon, H.E.P. in Western Europe.

Figure 11. Hydro-electric Power in the French Alps.

has been accompanied by increased prosperity in the peasant farming and a general raising of the standard of living. Hydro-electric power stations and industrial establishments are almost entirely on the left bank. The right bank has relatively few and short streams from the Prealps while on the left there are plenty of streams from the Belledonne Massif, all usable from the confluence of the Arc in the north to that of the Drac in the south. Here most of the power is used on the spot, in sawmills, papermills, forges, electro-chemical works and electro-metallurgical works. Power from stations at the edge of the valley is supplemented from stations higher up the tributary streams. Allevard, Brignoud, Lancey, Domene, are some of the settlements where industry is most prominent.

Beyond Grenoble comes the valley of the Drac; its development came late and is not so extensive; at the lower end its power production is associated with the industries of Grenoble (q.v.). Higher up the Drac flows in deep gorges; while it is possible to build power stations here, the conditions are not suitable for the development of associated industries. Near Corps is the big reservoir held up by the Barrage de Sautet, but the power is exported to the south coast and does not affect local settlement to any marked degree.

The big interior valleys, the upper Isère, the Arc, the Romanche, were early made accessible by railways and these well-peopled valleys became the site of metallurgical and electro-chemical industries. These glaciated valleys, crossing the hard rocks of the Briançonnais and the crystalline rocks of the Mont Blanc and Pelvoux massifs, have many breaks of slope, besides the opportunities offered by tributary valleys. Moutiers is the important centre in the upper Isère valley; on the main river the verrou of St. Marcel is the site of the Pomblière station but otherwise the main stream is less important than the Doron de Bozel with its chemical works. The highest part of the Isère valley will play the central part in the Emalp scheme (17). The great defiles cut between the Graian Alps and the Venoise massif, alternating with broad flat-floored basins, lend themselves to the construction of high barrages. The vast reservoir created will be kept at a sufficient level by water drawn from many parts of the Western Alps, not only in France but also in Switzerland. The Val d'Isère will supply stations

(17) A.F. Mutton, H.E.P. in Western Europe (Geog. Journal 1951). p. 329.

in France, Italy and Switzerland and the surplus water will help to increase the flow of the Isère and the Rhône when they are at their minimum. New stations in the French Alps will be at Moutiers on the Isère and at Aiguebelle on the Arc. The extra power available may be used for the aluminium industry (French bauxite from Var now goes to Brig and Visp in Switzerland), and further electro-metallurgical and electro-chemical industries. A very different effect on settlement sometimes involved in enterprises of this kind is exemplified in the Val d'Isère where the creation of the reservoir has necessitated the complete removal of the village of Tignes to a new site. Much of the power to be produced is designed for markets outside the Alps but if the scheme is carried out in full it will plainly affect the character and development of many of the mountain valleys in Switzerland and Italy as well as France.

The third interior valley of importance is that of the Romanche. The river carries plenty of water and the rapid fall of the river in cutting through the crystalline massif of Belledonne-Taillefer gives plenty of potential power. There are works in rapid succession as far up as Livet; above that the tributaries of the Eau d'Olle and the Venéon are used and there is the Barrage de Chambon on the Romanche itself. This valley is near enough to Grenoble to be stimulated by that centre of industry and trade.

Only the northern part of the French Alps has been taken for this example since in the southern Alps climate and relief are less favourable, except in the Durance valley which shares the characteristics of the northern valleys. However though there is not such intensive use of power the demands of the well-populated coast and the port of Marseilles have stimulated production, the major works being on the Verdon (tributary to the Durance) and the Var. The latter flows through the Maritime Alps which being exposed to the sea have a heavier rainfall than the mountains of Lower Provence.

JENBACH (AUSTRIAN TIROL)

Numerous small industries are to be found in mountain areas which supplement the limited possibilities of agriculture and make possible the growth of larger settle-

ment than would otherwise arise. This is true of many parts of the Alps; the industry may be based on some local raw material, mineral or agricultural. Besides the considerable iron industry of Styria the Austrian Alps have smaller local examples. In the Inn valley, for instance, Hall with its salt mines; the little town of Schwaz with its mediaeval prosperity from silver mining, and, across the valley, Jenbach, old iron-working centre famous for its scythes. The latter small town (Figure 12) also serves to illustrate the more modern kind of mountain industry. Behind it to the north rise the rocky Karwendelgebirge broken at this point by a transverse glacial valley which is occupied by a deep (436 feet) lake, the Achensee. This drains northwards towards Germany through the Achen Pass. The surrounding ranges are limestone and despite the heavy rainfall (Pertisau 70" per year) the watercourses are rarely full as the water percolates underground. The mountains slope very steeply to the lake and the steep gullies end with considerable detrital cones which have grown out into the lake. There are villages at each end of the lake and in the silted-up 'inlet' of Pertisau. At the southern end of the lake only a low hummocky saddle of morainic material separates the lake from the sharp drop to the Inn valley. It has been simple to reverse the drainage; a pipeline draws off the water, tunnels through to the Inn valley and after a fall of 1,100 feet feeds an electric power station close to Jenbach. Much of the power is used by the railway and farther afield but locally it serves an engineering works at Jenbach. Water power also serves a series of sawmills on the stream coming down from the saddle and through Jenbach but this is derived from the stream itself, not the lake.

The level of the lake varies considerably during the year; in winter when the precipitation is locked up in the form of snow and ice it falls many feet, and there are landing stages at three different levels for the steamers which provide the main means of communication between the lakeside settlements. In addition the level was being permanently lowered as the amount of water draining into the lake was not equal to the demands of the power station. This made necessary additional works to supplement the water supply; the Ampersbach, tributary of the Achen river, was tapped by a canal 3 miles long leading into the lake and more elaborate works will tap the water of the neighbouring Buchental.

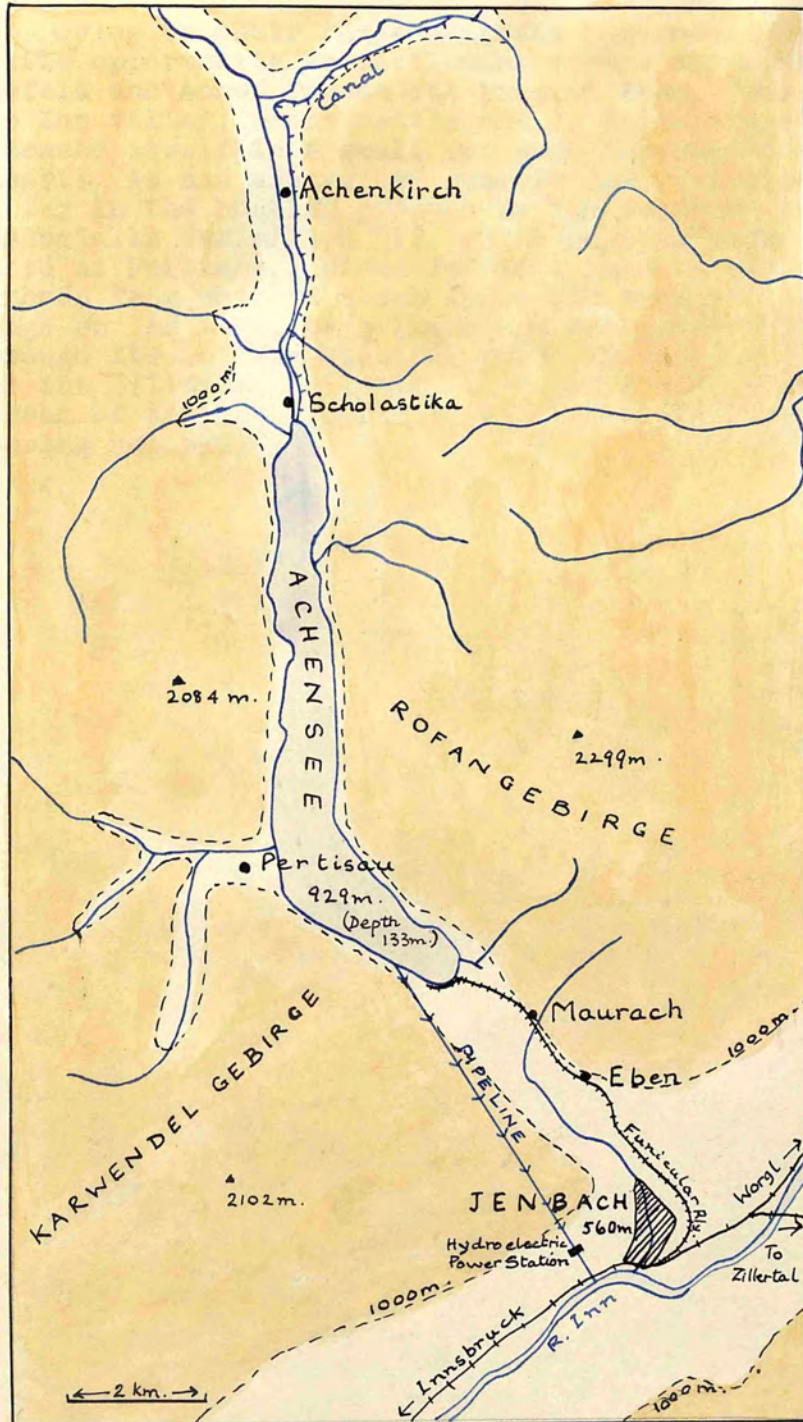


Figure 12. Jenbach and the Achensee, Austrian Tirol.

Owing to their ruggedness the Karwendelgebirge give little opportunity to settlement except where the Fern, Seefeld and Achen Passes cut through them. They shelter the Inn valley, where settlement is concentrated. The Achensee itself is a small but much frequented tourist resort; it has always had recreational associations as it lay in the hunting grounds of the Hapsburg Emperors (especially Maximilian II) whose hunting lodge was situated at Pertisau. Since Pertisau must be reached via Jenbach from which a steam funicular runs to the landing stage on the lake, this increases the passenger traffic through its railway station, which is also the junction for the Zillertal railway; this has a more important stream of tourist traffic to Mayrhofen and its neighbouring valleys.

SECTION III

TRADING SETTLEMENTS.

Since mountains present obstacles to routes, they restrict trade and concentrate traffic at certain points which thereby become the more important by contrast, although the total amount of trade will be less than in a more productive lowland area. The principal type of trade associated with mountain areas is one of the oldest in human history, the exchange of products with neighbouring plains, as for example, between the cities of Mesopotamia and the Persian highlands; as for the positions of trading towns (and trading settlements are likely to be towns since it is this very activity which causes the development of a town rather than a village), frequently they are placed at the edge of the highlands, where they can engage in this interchange of very different types of commodities. Their sites are often coincident with those of strategic settlements, since both are intimately concerned with routes, though from a different point of view.

Many settlements, however, are largely concerned with transit trade, which has no relationship to the economy of the mountains themselves, but arises from the position of the ranges forming a barrier between two other regions with differing products; this is true of most of the major mountain ranges of the world. The important towns are then located with relation to the most important passes through the range. Very often they are at confluence sites, and in some major valley which provides a corridor running for into the mountains or between parallel ranges.

Smaller trading settlements may be situated where such a major route meets a minor one coming from tributary valleys. As the size of a river is governed by the extent of its catchment area, so the growth of such a town is determined by the number of settlements and the state of economic development in its tributary valleys. The population of the town itself, though it may well be partly agricultural, will contain a fair proportion of merchants and innkeepers.

Europe, with its long commercial history and high degree of economic development can provide a multitude of examples of every type, especially in the Alps. This range, despite its very real character as a barrier, is particularly well provided with negotiable passes (Mt. Cenis, St. Bernard, Simplon, St. Gotthard, Splügen, Brenner, to men-

tion the most important). Many of the towns which have benefited most by the traffic through them are outside the mountains, albeit at their foot on the Italian plains (Turin, Milan, Verona) or on the Swiss Plateau (Zurich, Basle). The largest truly Alpine city closely associated with a pass is Innsbruck, the pass in question being the Brenner. This city, like other important towns in the Alps, is also situated in the Inn valley, one of the great longitudinal troughs which are a marked feature of the range. Brig, at the northern end of the Simplon Tunnel, is in the Rhone trough. Merano lies at a cross roads in the Adige trough. Most important of all, Grenoble lies in the great Sub-Alpine Trench of the French Alps, at the southern end of the rich region of Grésivaudan.

The local market towns often develop where a tributary valley enters one of these great valleys, for example Jenbach (q.v.) in the Inntal, Sierre in the Rhone valley. Or where valleys open out at the edge of a range, as Thun stands at the edge of the Bernese Oberland, with the Simmental and Kandertal tributary to it. In the Eastern Alps Klagenfurt exemplifies a different situation; it has developed in the centre of a basin in the valley of the upper Drava. This importance has given it the lead over Villach, which lies a little higher up the valley and has an important crossroads position where the railway from northern Italy reaches the Drava valley after crossing the Carnic Alps.

In that once independent mountain kingdom of Navarre in the Western Pyrenees, the capital, Pamplona, if not a mountain town, at 1,400 feet is definitely an upland town, encircled by hills, and the commercial focus for the valleys descending from the Pyrenees to the north and from the Sierra de Aralar to the west. The Pyrenean valleys in question are those of the upper Arga (the river on which Pamplona stands), Erro, upper Irati (Aezcoa), Salazar and Roncal. Secondary markets are situated at confluence points in the foothills or where the valleys open out from their narrower upper sections, e.g. Burguete, Arive, Abaurrea Alta, which serve their own valleys, and neighbouring ones, where there are means of communication between them. Some details of the situation of Burguete and Arive have already been given in discussing the agricultural settlement in this area (page 26-27). Increasing motor transport is encouraging the development of the larger regional markets at the expense of the smaller local ones.

In Asia's vast expanse of mountains and plateaus there are many trade routes of great antiquity. Some of these pass through the mountain barrier which surrounds the north of India and Pakistan; the most famous is the route from Peshawar through the Khyber Pass the Kabul in Afghanistan. Others pass through the Himalaya and Karakoram ranges in Kashmir on their way to the Tibetan Plateau, through towns separated from each other by many days journey through barren ranges. The most important trade route of Kashmir goes through Srinagar to Leh by way of the Zoja La in the Saskar Range and thence over the Karakoram pass to Shigatse in Tibet and to Lhasa. Through Gilgit and Hunza goes the road to Kashgar in Sinkiang. Farther east Darjeeling commands the principal route from India to Lhasa, going by way of Kalimpong over the Dzelep La and by the Chumbi valley to Phari and Lhasa. Various routes through the Nepal Himalaya are described below. Finally through the lower ranges which separate Assam and Burma bullock cart roads go via the Hukawng valley and via Manipur. From Burma eastwards, besides the 'Burma Road' from Lashio to Chungking, routes go into the Shan states and to Siam.

The people of Tibet are keen traders despite the inaccessible character of their country. Routes to India have already been mentioned. The road from Lhasa to China goes through Chamdo and thence through either Batang or Kanze to Tachienlu; Tibetan wool is exchanged for Chinese tea. It is a difficult way over parallel ranges and deep valleys; not only are the climbs up and down exhausting, but the climatic variations bring their own peculiar dangers. North from Lhasa a road leads through Nagchuka and Chang Tang to Ulan-Bator (Urga) in Mongolia. Though the whole of Mongolia is high the routes there do not partake of the character of mountain routes except where they are crossing the ranges which separate the plateaus and basins of central Asia, therefore they will not be specifically mentioned here. Mention must be made of the Pamirs, which, more than Tibet, deserve the name of 'the roof of the World'; despite their height very ancient routes traverse them. One is the route which was taken by Marco Polo, up the Oxus (Amu Darya) valley via Sarigol to Kashgar and Yarkand. The other is the ancient road by which silk came from China to Greece and Rome; from headwaters of the Kashgar river and so down to Kashgar. Despite great heights and distances, snow and ice, and

primitive methods of transport the traffic creeps slowly and steadily across the mountains and the trader is as typical of Central Asia as is the oasis farmer of the nomadic Khirghiz shepherd.

In the New World North America offers a complete contrast to Asia in the sense that its mountain routes and settlement are all of very recent date; it is not much more than a hundred years since the first journey was made from east of the Rockies to the Pacific coast; the first transcontinental railway (the Union Pacific) was completed in 1869. Settlement and development of the west coast proceeded quite independently until the rail link was created, so that it was a very significant event in the history of the United States (and of Canada likewise in 1885 when the Canadian Pacific line was opened). The traffic is mainly transit trade, since mountain settlement is still sparse. In the United States there are three main lines. The Northern Pacific passes through the mining areas of western Montana and the Columbia Plateau wheatlands and for this reason has more local traffic than the Union Pacific which has an easier route through the lowest part of the Rockies and is the most direct route to San Francisco, but which passes through very unproductive country for the most part. The third route, from New Orleans to San Francisco, likewise has little to collect en route. The route along the Rocky Mountain front, connecting Cheyenne, Denver, Pueblo and Trinidad is significant, for here is a string of mountain border towns, the gateways to the mining areas of the Rockies.

Canada's transcontinental railways, the Canadian Pacific and the Canadian National, use the three passes, Crowsnest, Kicking Horse and Yellowhead, to cross the main range of the Rockies. The two branches of the C.P.R. then cut across the ranges of British Columbia, linking up the fruit growing longitudinal valleys. Some settlements have been virtually created by the railway. Such a one is Prince George, at the confluence of the Nechako river with the Fraser where the latter makes its great bend southwards; the settlement was founded in the hope that this was to be the site of a railway junction. It is on the Edmonton - Prince Rupert line (C.N.R.); a railway is being constructed northwards towards the Peace River country. Another railway town is Field, near the Kicking Horse Pass; it is situated on a steep alluvial fan in a glacial trough. Its 'raison d'être' is simply the fuelling and watering

of locomotives, and railway repair shops. It has some pretensions towards the tourist trade, but its railway yards and works hardly contribute to its attractions nor does its narrow valley provide a good viewpoint. This is not a trading town in the strict sense of being a market but nevertheless it is created by the requirements of the traffic on the railway.

A special feature of South American mountain trade is its association with the mining areas of the Andes and their requirements in the way of food and transport animals. This traffic between agricultural and mining settlements has already been referred to, in connection with the nature of Andean farming. Towns where the influence of this trade is particularly evident are to be found in the sub-andine region of Argentina. There is for instance Jujuy, from which a long established route, now followed by the railway to the Bolivian plateau, runs up the Humahuaca quebrada to Tupiza, Oruro and La Paz. Salta and Tinogasta are stages on routes by which stock is driven from the Pampas to mining districts in Northern Chile, Bolivia and Peru. There are irrigated pastures for the grazing of the stock. Cattle and mules are driven annually across to Copiapo, across the high arid Puna to the nitrate fields, and via Humahuaca to Huari in Bolivia. The railway from Jujuy stimulates this traffic, as will the Salta - Antofagasta line across the 12,000 ft. high Puna (completed in 1946); railway transport helps to reduce the losses inevitable in driving cattle across such high and difficult country. On the other hand, Tinogasta and some other towns are suffering as a result of railway development, for the railways which run across the Pampas to the foot of the Andes but do not cross them, have drawn away to Buenos Aires cattle which might otherwise have entered into the trans-andine trade. The Trans-andine railway which links Buenos Aires and Valparaiso carries few goods, mainly passengers and mail, for it has two changes of gauge, at Mendoza and Los Andes, and this seriously limits its usefulness.

Certain general features of trading settlement in some of the major mountain areas of the world having been indicated, there follow some examples of individual settlements treated in more detail, three of them from Europe and one from Asia.

GRENOBLE

ROUTE FOCUS OF THE FRENCH ALPS (15)

The population of Grenoble with her suburbs is more than 100000; it is an exceptionally large town to be situated within a major mountain range and is the largest Alpine city, for the cities of Switzerland such as Zurich and Bern lie on the plateau and not in the Alps, and Graz in Austria is situated in the Styrian foothills; only Innsbruck is comparable. Passes through the Alps have played an important part in the growth of Turin, Milan and other Italian cities, but they themselves are outside the mountains.

Grenoble is situated in the Sub-Alpine Trench where three valleys meet, the lower Isère, the upper Isère (Grésivaudan) and the Drac (Figure 13). In Grésivaudan the Isère is a wide river, with wandering channels and is very liable to flood. Where the Drac enters from the south the cone of deflection of that river forces the Isère against the steep rocky slope of the southern end of the Chartreuse massif. This causes the river to be restricted to one channel here and made it possible to cross the Isère above its confluence with the Drac. Since, coming from Lyons, it is necessary to cross the Isère to reach any of the major passes on the French - Italian frontier, this fact alone makes the site an important one. Indeed it overcame the other very considerable disadvantages of the site, of which the greatest was the danger from the floods of the Isère; the city suffered several catastrophes of this type in her long history.

The ancient Gaulish city (Cularo) was on the steep and rocky right bank but the Roman (Gratianopolis) and the mediæval cities developed on the lower lying left bank near the crossing east of the Drac. The place has had a turbulent history; many armies passed through it and the growth of the town was an erratic one, according to its political fortunes. It was the centre of the County of Grésivaudan and later became the capital of Dauphiné. Figure 13 illustrates the routes which it commands, down the Isère to Lyons, south along the Drac to the Col Bayard and so to Gap (the modern 'Route Napoléon'), or over the Col de la Haute Croix to the lower Durance and Marseilles, up the Romanche valley to the Col du Lautaret and so to Briançon

(18) R. Blanchard. Grenoble. Grenoble, 1935.

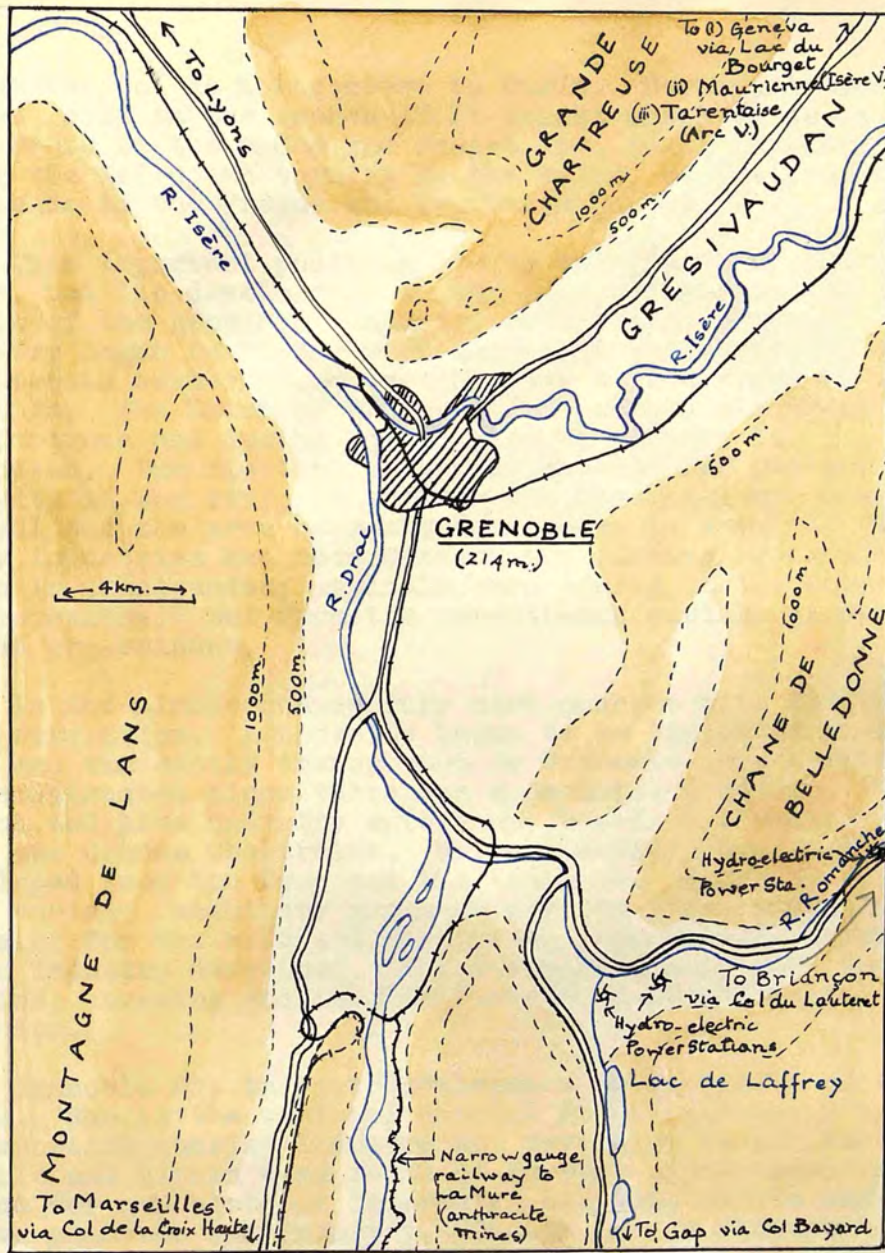


Figure 13. Position of Grenoble.

and by the Col de Montgenèvre to Turin. Northwards Grésivaudan leads to the trench of Le Bouget which gives an easy route to the Rhône and Geneva, or, going farther along the Isère and turning up the valley of the Arc, the way leads to the Fréjus and Mr. Cenis Passes.

This important position led to the growth of the city there, but its development to its present size is the result of the growth of industry rather than trade. Industry began to become more important than trade in the seventeenth century when Grenoble was a prosperous Huguenot town. The Edict of Nantes (1685) caused a setback in its fortunes and during the eighteenth century it stagnated. The nineteenth century however saw renewed activity in the city; the river was brought under better control and the area near the Drac began to develop. Its early industries had been weaving and tanning (flax was grown in Grésivaudan; animals were reared on the surrounding mountains) but from the seventeenth century glovemaking became pre-eminent.

In the nineteenth century came changes with the industrial revolution. Anthracite began to be exploited at La Mure and was easily transported to Grenoble once a railway was constructed since there was a downhill gradient. A cement and lime industry sprang up, based on limestone from the Grande Chartreuse. Hydro-electric power was developed from the Drac and the Romanche. Industry became more varied; machinery was made for the glove industry and also for the silk and electrical industries; later the rayon industry developed. There are also some food industries; brewing and the manufacture of chocolate and biscuits.

Grenoble has in fact developed a multiplicity of functions. She is the regional capital and a university town; an important tourist industry has developed as she is accessible and within easy reach of so much alpine country, beside her own historic interest; all this beside her active commerce and industry. Though low in altitude (600 ft.) she is in and of the Alps and the bases of her development are factors of mountain geography.

INNSBRUCK

Innsbruck in the Austrian Tirol provides a good example of the way in which valley and pass routes have promoted the growth of a considerable settlement. The great Brenner Pass on the Austrian - Italian frontier is only 1,362 metres

high; there is a general depression in the main range here with lower peaks. The northward-flowing Sill has been decapitated by tributaries of the Adige and glaciation has further modelled this passageway, the morainic accumulation favouring agriculture and settlement. From very ancient times this was an important routeway, and it has made the fortune of Innsbruck which is situated where the route from the pass enters the broad longitudinal valley of the Inn. The route then continues northwards by the Seefeld Pass over the Austrian Prealps (Karwendelgebirge) to Munich (Figure 14.)

The Inntal itself, eroded in less resistant schists between the calcareous Prealps and the crystalline main range, provides an important east-west line of communication in part of the Alps, though to the west the road must cross the Arlberg Pass (1802 m.) to reach the Rhine valley and the Swiss Plateau, and to the east, from Worgl follow a devious course to reach the similar stretch of the Enns valley. With favourable conditions for agriculture on the numerous terraces and with long established mining and textile industries the Inntal has a comparatively dense population.

Innsbruck then lies at the junction of a great trans-alpine route with a longitudinal route through a well populated valley and therein lie the reasons for its growth. The Roman town of Veldidena grew up at Wilten on the alluvial cone of the Sill and the mediaeval town likewise stood on the right bank of the river. In the Middle Ages there was much traffic over the Brenner Pass for political and economic reasons. The Holy Roman Emperor, more or less controlling the turbulent German princes north of the Alps, held also but less effectively the northern half of Italy; tradition, if at times nothing more, linked him with his spiritual co-ruler, the Pope, in Rome. The Brenner has only very recently become a frontier. The great mediaeval trade routes ran between the Italian ports dealing with the trade from the Levant, and western and northern Europe. There was much traffic over the Brenner Pass between the important port of Venice and the German cities of Augsburg and Nurnberg. In the fifteenth and sixteenth centuries strong Italian city states and the incursions of France into Northern Italy weakened the political link; the discovery of the New World brought into prominence the Atlantic seaboard and transoceanic routes; the Mediterranean declined in importance and with it the importance of this trade.

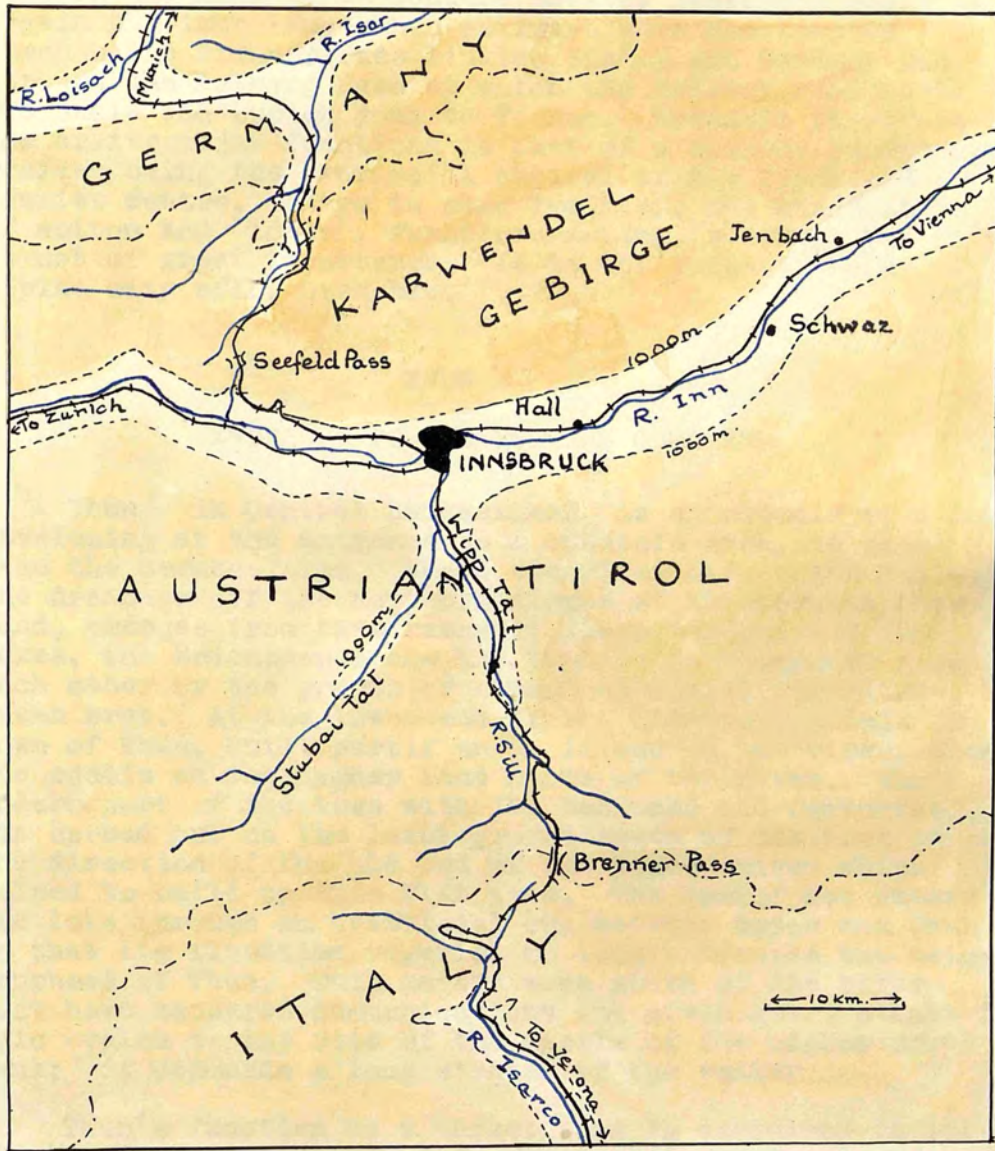


Figure 14. Innsbruck and the Brenner Pass.

In the nineteenth century however Innsbruck began to regain her importance when railways were constructed through the Brenner Pass linking Italy and Germany and through the Arlberg Pass by which the railway from Paris via Basle and Zurich goes to Vienna. Nowadays therefore one of its major functions is that of a railway junction, besides being the provincial capital of the Tirol and a tourist centre. There is some industry, the manufacture of cotton and 'loden', furniture-making, brewing, but it is not of great importance. It is the largest truly Alpine city after Grenoble.

THUN

ENTRANCE TO THE BERNESE OBERLAND

Thun, in Central Switzerland, is an example of a town developing at the entrance to a mountain area, in this case the Bernese Alps. Where the river Aar, which collects the drainage off the northern slopes of the Bernese Oberland, emerges from that range it flows through the two lakes, the Brienzensee the the Thunersee, separated from each other by the growth of stream deltas in the Interlaken area. At the lower end of the Thunersee stands the town of Thun, built partly on an island in the river, with the castle on the higher land north of the river. The modern part of the town with its barracks and factories has spread out on the level ground south of the town in the direction of the old bed of the Kander river which helped to build up this flat area. The Kander now enters the lake through an artificial cut between Spiez and Thun so that its floodtime vagaries no longer trouble the neighbourhood of Thun. This marshy area south of the river must have hindered communications and given great strategic value to the site of the castle of the higher north bank; it commands a long stretch of the valley.

Thun's function as a market town is exercised in relation to the Simmental and the Kandertal which converge on the lower end of the Thunersee, cattle-rearing and dairying areas, and the business of the market is mainly the sale of the Simmental breed of cattle and also of pigs; the modern tourist industry has increased the importance of the town since it lies on the route to all the Oberland resorts, Interlaken, Grindelwald, Murren, Spiez, Kandersteg, Adelboden. Since 1912 the railway junction here has become important as a result of the construction of the Lötschberg Tunnel through which trains from Basle and

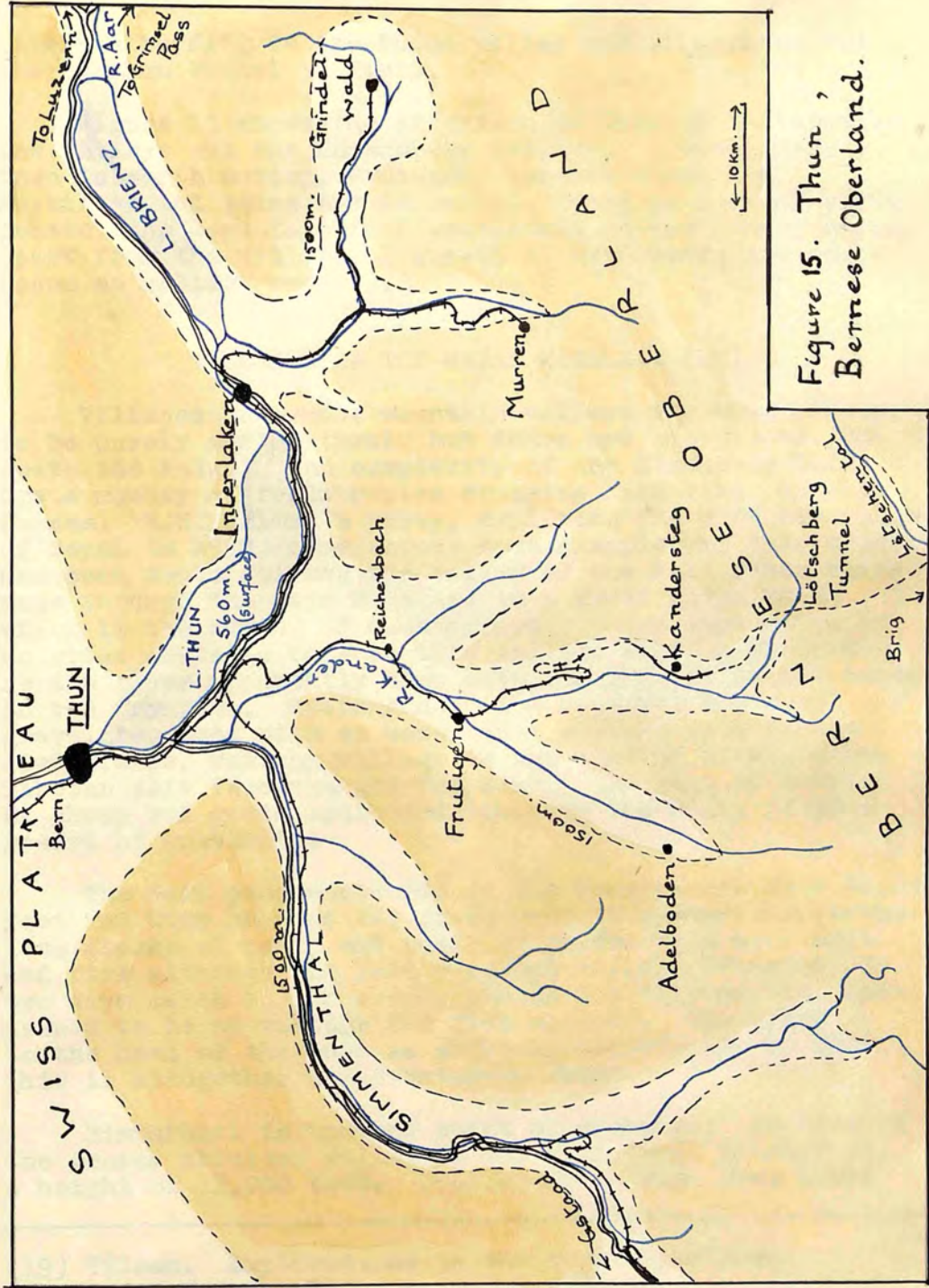


Figure 15. Thun, Bernese Oberland.

Bern run to Brig in the Rhône valley and from there via the Simplon Tunnel to Italy.

Figure 15 shows the situation of Thun in relation to the valleys and the Lötschberg railway. A subsidiary town is worth noting, Frutigen, located where the Engstligental joins the Kandertal. Here is a minor route centre, the most important settlement in the Kander basin, apart from the artificial growth of Kandersteg and Adelboden as holiday resorts.

VILLAGES IN THE NEPAL HIMALAYA (19)

Villages in remote mountain valleys are most likely to be purely agricultural, but there are exceptions. Despite the height and complexity of the Himalayas there are a number of trade routes crossing into Tibet by high passes. H.W. Tilman's party, exploring the northern valleys of Nepal in 1950, came across some examples of this trade. One such route follows the valley of the Kali river which cuts through the main Himalaya in a great gorge above which is the region of Mustangbhot; there appears to be no great obstacle between this and the Tibetan Plateau as the river apparently also cuts through the Ladakh range on the frontier. Mustangbhot is a desolate waste of gravel terraces with an occasional village with irrigated fields. Mustang village is the trading point, where Tibetan salt is exchanged for rice. The salt is carried by sheep and goats southwards through the Hindu pilgrim resort of Muktinath.

The next pass eastwards is the Kongyur La, over 19,000 feet and with snow on the crest even in summer; nevertheless flocks of sheep and goats cross the pass with salt and rice although the last Nepalese village, Phugaon, is two days march to the south, and on the Tibetan side there is said to be no village for five marches. The track to the head of the pass is swept by stonefalls, so that this is altogether an adventurous route.

Bimtakhoti is another point of exchange; it lies in the grassy ablation valley of the Dudh Khola glacier at a height of 12,000 feet. Coolies bring rice from lower

(19) Tilman. Explorations in the Nepal Himalayas. Geog. Journal 1951, p. 263 - 272.

Nepal; sheep carry the salt over a 17,000 ft. pass from Larkya in the next valley to the east, the Buri Gandaki, after it has come by an easy pass, the Gya La, in the Ladakh range, from Tibet. About 3,000 animal loads are dealt with in a season. Yet another village dependent on the salt and rice trade is Namche Bazar (11,000 ft.) in the Dudh Kosi valley; the traffic goes over the Nangpa La (19,000 ft.) to Tingri Dzong and Rongbuk.

Another type of trade is illustrated from the villages of Manangbhot, the upper Marayandi valley. These villages, similar in character to Tibetan villages, lie at about 11,000 feet. The inhabitants are more sophisticated than might be expected in such a remote spot, for in the winter months they trade medicinal herbs and skins as far afield as Delhi, Calcutta, and even Rangoon and Singapore. Thus they can live in greater affluence than their mountain agriculture would permit though they appear to have sufficient agricultural land; however the lightness of the rainfall necessitates irrigation for their wheat and buckwheat crops.

SECTION IV

STRATEGIC SITES

A mountain range as a whole has great strategic importance since it constitutes a natural boundary zone and defence, by restricting communications to routes which can usually be easily defended. The Alps in relation to north Italy, the Pyrenees in relation to Spain, the Sudetes, Ore Mountains and Bohemian Forest in relation to western Czechoslovakia, fulfill this function, or have done so in the past. The history of states within mountain areas witnesses to their relative security and independence; Switzerland is the supreme example, but the isolation of the Balkan states, the aloofness of Tibet, the survival of Andorra, the independence of Abyssinia in a European-dominated Africa, all point to the same conclusion. The nucleus of Switzerland was not the rich trading cities of the plateau but the forested valleys on the northern slopes of the Alps. As the federation grew it was not only the accession of the Plateau cities (e.g. Zurich, Bern) that gave it strength, but the control that they acquired over the St. Gotthard Pass route, which, like the Mt. Cenis, has the advantage of only one major ascent and descent to cross the Alps. The history of this route emphasises the fact that passes are not necessarily the most difficult part of a mountain route. It was not the character of the pass but the difficulty of passing the gorge of the Reuss to the north which hindered the development of traffic until the building of the bridge in the early fourteenth century. The Swiss cantons controlled the more difficult northern part of this route and were able to extend their political influence across the pass into the upper Ticino valley.

Since strategic points are significant by virtue of their control of routes, some of the examples already mentioned in the discussion of trading settlements have their strategic importance too. Thun, for instance, has a good defensive site, its castle standing on a narrow hill by the bank of the river Aar, just where an island facilitated the bridging of the river and where the marshes below Lake Thun forced the road on to the slope north of the river. However this was a site of limited importance since the upper Aar and its tributaries above Thun lead to no outstandingly important passes (the Oberland passes in any case lead only over into the upper valley of the Rhone); the Lötschberg Tunnel, which puts Thun on a major

railway line to Italy, was only completed in 1912, so that the town's significance on a transalpine route is not of long standing.

The examples given above bring out some points which require further elaboration. First of all, there is the site itself; in order to be defensible and to command a route, it is likely to be on some elevation above the valley floor, an isolated rock or hill, or a projecting spur, overlooking the route where it is restricted by this very obstacle. Height, a commanding view, an approach by steep and difficult slopes, an accessible water supply are all essential factors in such a situation. There are plenty of such defensible places in the mountains, but the site is not used unless there is something to defend or control. The importance of the route along the valley or over the pass will decide to a great extent the importance of a defensible site. The importance of a route and of a particular point on it vary over a period of time owing to changing economic and political factors and to man's capacity to alter the character of the route. This also is evident in the case of the examples quoted, the St. Gotthard and Lötschberg routes. Up to the end of the eighteenth century the Alps were crossed only by mule paths, not by carriage roads. Slow moving traffic on bad paths was relatively easy to stop in any place of difficulty. On the other hand, more passes were in regular use than at the present day.

With the nineteenth century came the economic developments of the Industrial Revolution, bringing with them the need for better communications and transport. The new road building techniques of Macadam and Telford were put into use. A town mentioned already in the previous section as controlling Alpine routes is Grenoble. One of those routes crossed the Mt. Cenis Pass. The earliest carriage road across the western Alps was constructed over that pass during the Napoleonic Wars when political and strategic conditions focussed French attention on the importance of alpine routes. The fact that in northern Italy France and Austria faced each other as opponents during these wars meant that large armies were in close proximity to the mountains, and these armies had to cross the Alps from either country. Northern Italy and France were then temporarily united politically (1802 - 1815), and the sea route was rendered dangerous by the blockading British fleet. Later, towards the end of the century, the first railway tunnel was constructed on this route, not actually under the Mt. Cenis Pass but under the neighbouring Fréjus

Pass. The building of this, and the later tunnels of the Simplon, St. Gotthard and Brenner routes, has concentrated traffic through these passes at the expense of others. Thus the development of modern communications has affected the relative strategic importance of routes and of points on them. Moreover the control of a railway disappearing into the bowels of a mountain is a different matter from the control of a road pass. In places of difficulty a railway (and even in some places a modern road) is likely to be safely buried in a tunnel.

Man's progress in moving more easily and more quickly has been paralleled by his progress in the technique of killing his fellowmen. The rapid changes in military technique in the nineteenth and twentieth centuries have had an effect, at least equal to, if not greater than, the influences mentioned above. When, instead of rolling down boulders on the enemy's head, or bombarding him from a short range, it is possible to shell him with long-range artillery and drop bombs from aircraft which fly at sufficiently great heights to take little account of the mountain range beneath them the passes themselves and the once strategic points along the routes take on a less imposing aspect. A railway or road junction is still of importance, a bridge is of importance, but from a different angle. A bomber takes no account of whether there is a castle on a rocky knoll when aiming at a vital bridge or railway yard. To refer back to the starting point of this section, the Alps, the Pyrenees, the Czech mountains, no longer fulfill their barrier zone character so effectively.

These points have been discussed almost exclusively in connection with the Alps because their position in the middle of the political turbulence of Europe has resulted in the particular prominence of strategic sites in their ranges, more especially because despite their height they are crossed by so many passes. Because of the existence of these routes states have often lain across the Alps or have existed within the Alps. No other range has seen so much human traffic, of armies or merchants, cross it. The Asian mountains, by their size and extent are for the most part, and especially in the case of the Himalayas, such formidable defences with few passes that strategic settlements are few because routes are few. The mountains constitute rather a gigantic no-man's land. In South America boundaries run along Andean ranges only between Chile and Argentina, and between Chile and Bolivia.

Frontier regions there are thinly settled, again a no-man's land. Bolivia, Peru, Ecuador, Colombia, Panama, Costa Rica, Nicaragua, Guatemala, Mexico, lie astride the American Cordillera. This causes internal difficulties of administration and national economy but reduces the strategic importance of the ranges since they are not frontier regions.

A mountain region as a frontier zone, is not, then, quite as simple a proposition as might appear at first sight, both for the reasons given above and for others not relevant to this discussion. The significance of potentially strategic positions varies so enormously with the political conditions prevailing, the state of communications, the military strength of neighbouring countries, the weapons of war available, that it is difficult to generalise except in the widest terms. It will be clearer to proceed to some specific examples to illustrate the operation of the physical and human factors involved. For reasons that should now be clear their treatment is necessarily from the historical point of view. The factors which originally promoted the development of the town may not now be operative, or only in a diminishing degree. Trento and Sion both stand at restrictions of major valley routes; both are also administrative centres, a direct result of their strategic position, which caused them to be occupied in Roman times, giving them an early start as centres from which law and order held sway. Briançon serves as an example of a fortress town in close proximity to an important pass, being at the same time a route centre, and also a characteristic site in a glaciated valley. Burguete and Roncesvalles, on the southern side of the Pass of Ibañeta in the Pyrenees, illustrate the smaller settlements of a less important pass, whose traffic developed a special character of its own owing to the preponderance of pilgrim traffic in the Middle Ages on their way to Santiago de Compostella.

TRENTO

FORTRESS TOWN IN THE ADIGE CORRIDOR

From Verona to Bolzano the Adige Valley (Figure 16) provides the routeway by which the Brenner Pass is reached from the south; thereafter it uses the Isarco Valley (the uppermost section of the Adige leads to the less important Reschen Pass). The Adige valley is a glacial trough,



Figure 16. Trento, Italian Alps.

about a mile wide, and where Trento is situated, a precipitous crag, the Doss Trento, blocks half the valley and has caused the river to swing eastwards. This constriction of the valley gave this point strategic value since it controls the important Brenner route. The Romans first penetrated into the Alpine valleys in 43 B.C. and finally subdued this region in 15 B.C. when the province of Raetia was instituted (20). The road through the Brenner Pass was constructed during the reign of Claudius and the settlement of Tridentium (in the country of the Tridentini) was a station on this road from Verona, which controls the route where it leaves the Italian Plain (20). The gorge through which the Adige flows between this city and Trento is the most significant restriction on this route. The Roman fortress of Verruca later crowned the Doss Trento. In its heyday the Roman Empire extended into Germany, thus including the Brenner Pass well within its borders, but with the pressure of barbarian tribes during its decline the boundary retreated south of the alps and this area became a debatable land. By 473 not the Romans but Germanic Odavacar was ruling in northern Italy. In 490 came the Ostrogothic Kingdom of Theodoric; he attempted to stay the flood of invasions by fortifying the passes (21). After his death the Franks occupied the Trento area in 539, and the Gothic Kingdom was overthrown by Belisarius the general of Justinian. During Justinian's attempt to restore the Empire in the west (which only resulted in the devastation of Italy) a line of fortresses was established, of which Verruca was one, commanding the southern approaches to the passes, but this did not endure long. (22) In 568 the Lombards invaded Italy through the Julian Alps and they held the Alto Adige region for 200 years until they were defeated by Charlemagne in 774 and Trento became part of the Kingdom of north Italy (23).

As already mentioned in the section on Innsbruck the connection between the Holy Roman Emperor and the Pope and the extension of the Empire into northern Italy made the Brenner route important in the Middle Ages. This

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- (20) Cambridge Ancient History, Vol.X. ch. XII R. Syme.
The Northern Frontiers under Augustus. p. 349-50
- (21) Cambridge Mediaeval History, Vol I. ch. XV M. Dumoulin.
The Kingdom of Italy under Odavacar and Theodoric.p.438-9
- (22) Camb. Med. Hist. Vol. II ch. VII L.M. Hartmann.
Imperial Italy and Africa. p. 225.
- (23) Camb. Med. Hist. Vol. II ch. XIX G. Seelinger.
Conquests and Imperial Coronation of Charles the Great
p. 599.
-

extension of power to the south was facilitated by the easy passes. In 1027 the Emperor Conrad II bestowed temporal rights on the Bishop of Trento which henceforth was linked politically with Germany, not Italy. The Bishop retained his political power till 1803 when it passed to Austria (24). From 1810 to 1814 it was the capital of the Alto Adige province of Napoleon's Kingdom of Italy. Thereafter it was annexed to the Tirol and remained part of Austria till 1918. Throughout this period (except in the Napoleonic phase) the boundary, first of the bishopric, then of Austria, lay a little to the south of Trento, crossing the gorge mentioned above. At Trento two small side valleys enter the main valley of the Adige, that from the west carrying the route from Lake Garda, that from the east, the route from Padua via the Brenta valley. Thus Trento commands not only the route from Verona, but the alternative approaches which these other two routes provide.

The mediaeval castle was built, not on the crag, but on the opposite (east) side of the valley. Originally the old walled town bordered the river, but the old meander which brought the river close to the eastern slope was eliminated when the river was straightened about 1850, and modern industrial development (ferro-alloys, chemicals, woollen and cotton goods) has occupied the area between the former meander and the present river. The better residential section has spread out on the slope east of the town, merging into the vineyards, while the business section has developed out to the south-west.

The town is now the capital of the province of Trentino which with the province of Bolzano to the north forms the autonomous district of the Adige Tirolese, which has its own regional Diet. There are many German-speaking people though they are not in the majority here, as they are in Bolzano province. Despite this fact, in view of the principles of self-determination evoked in 1918, the area passed into Italian hands, according to promises made in the secret Treaty of London in 1915. The fascist government attempted to Italianise the Austrian population but the Peace Treaty of 1947 provided for the autonomy and cultural rights of the two provinces.

The administrative function of the town is evidenced by the government buildings. This part of the Adige valley is very fertile and productive and this makes Trento also an important agricultural market. Its original industries were based on its local vines and on silk (note that it is

(24) Griffith Taylor, op. cit. p. 283.

on the route from Venice to northern Europe); its modern industries are related to its accessible position on a major railway and to the availability of hydro-electric power. The variety of functions has brought Trento to the moderate size of population of 37,000; the variety does not obscure the original basic attraction of the site, its strategic importance in relation to an important valley route. The fact that it was the scene of the famous Council of Trent which, sitting with interruptions, from 1545 to 1567, was the basis of the Counter-Reformation, is a reflection of its political and geographic situation at that time, an ecclesiastical territory within the bounds of the Holy Roman Empire yet not too far removed from the centre of the Church, Rome. Present-day political conditions have removed the frontier far from it up the Brenner Pass, but it is still impossible to reach the pass by main road or railway from Italy without passing through Trento. And while Switzerland retains her unviolated neutrality there is no other comparable crossing of the Alps between Germany and Austria and Italy. The modern technique of aerial warfare diminishes but does not altogether destroy the town's significance. Though ethnic considerations would seem to indicate a boundary north of Trento, as would economic factors, strategy rules otherwise. The Brenner Pass itself is less of a constriction on the route than the gorge which below Trento restricts the passage to the plain at Verona. This makes logical the historic position of the boundary here and explains the importance of Verona as a fortress, one of the 'Quadrilateral' (Verona, Mantua, Peschiera, Legnago) which controlled both the route along the Adige itself and the alternative route to Trento by Lake Garda.

SION

STRATEGIC SITE IN THE RHÔNE VALLEY.

The deep trench of the Rhône valley above Lake Geneva provides a major routeway between the Bernese and Pennine Alps. The wide almost flat floor of the valley is often marshy and has been avoided by settlement which seeks any kind of eminence. Thus most of the settlements (for example Brig, Visp, Gampel, Bramois) are situated on the alluvial cones of tributary streams; these are a marked feature of the valley. Sierre and Granges on the other

hand have taken advantage of small limestone residuals partly covered by glacial material. Sion combines the two types of sites (Figure 17). Twin hills rise from an elevation of schist on the north bank of the river; they stand up as a very prominent feature in the valley and command the road which passes between them and the northern slope; this defensible site has been made use of; the castle of Turbillon (1294), residence of the bishop, was built on the northern hill, the castle of Valeria, now a museum, and the church of St. Catherine (thirteenth century) on the other. The town of Sion (population 8,000) lies at the foot of the hills on the west side, spreading out westwards on to the small alluvial cone of the Sionne stream. The Rhône here swings right across the valley, for this fan pushes it towards the south side, whereas just above Sion it is forced right to the foot of the northern slope by the big fan of the Borgne, the river which issues from the Val d'Hérens. The village of Bramois is situated at the head of this fan.

In the Roman period the Helvetii were living in the Valais. The Romans tried unsuccessfully to occupy it in 57 B.C. to secure the St. Bernhard Pass route. The Helvetii however remained allies of the Romans and later on during the reign of Augustus they submitted to Roman rule and the Valais became at first part of the province of Raetia and afterwards part of the Alpes Graiae et Peoninae. The town of Sedunum was founded on the site of Sion. That this site rather than any other in the valley became the political centre of the Valais was chiefly determined by the fact that in 580 the bishop's seat was moved from Octodunum (Martigny) to Sion. Now when the Roman Empire was disintegrating, the Church's organisation of dioceses (which corresponded to the Roman 'civitates') survived the Germanic invasions, and the episcopal cities retained their prestige. As the feudal monarchies developed, they were poorly organised and their control over their dominions was weak, and these episcopal cities remained as important centres of law and order. The status of the clergy was enhanced by privileges in matters of jurisdiction and taxation and often they were vested with complete seigniorship over people and lands. In the case of Sion it became part of the Kingdom of Burgundy and in 999 the bishop received from Rudolph III, King of Burgundy, the title of Count of Valais, which he retained till 1798. In the fourteenth century the influence of Savoy was dominant in this area and Charles of Savoy became suzerain of the bishopric, which he secured to his family.

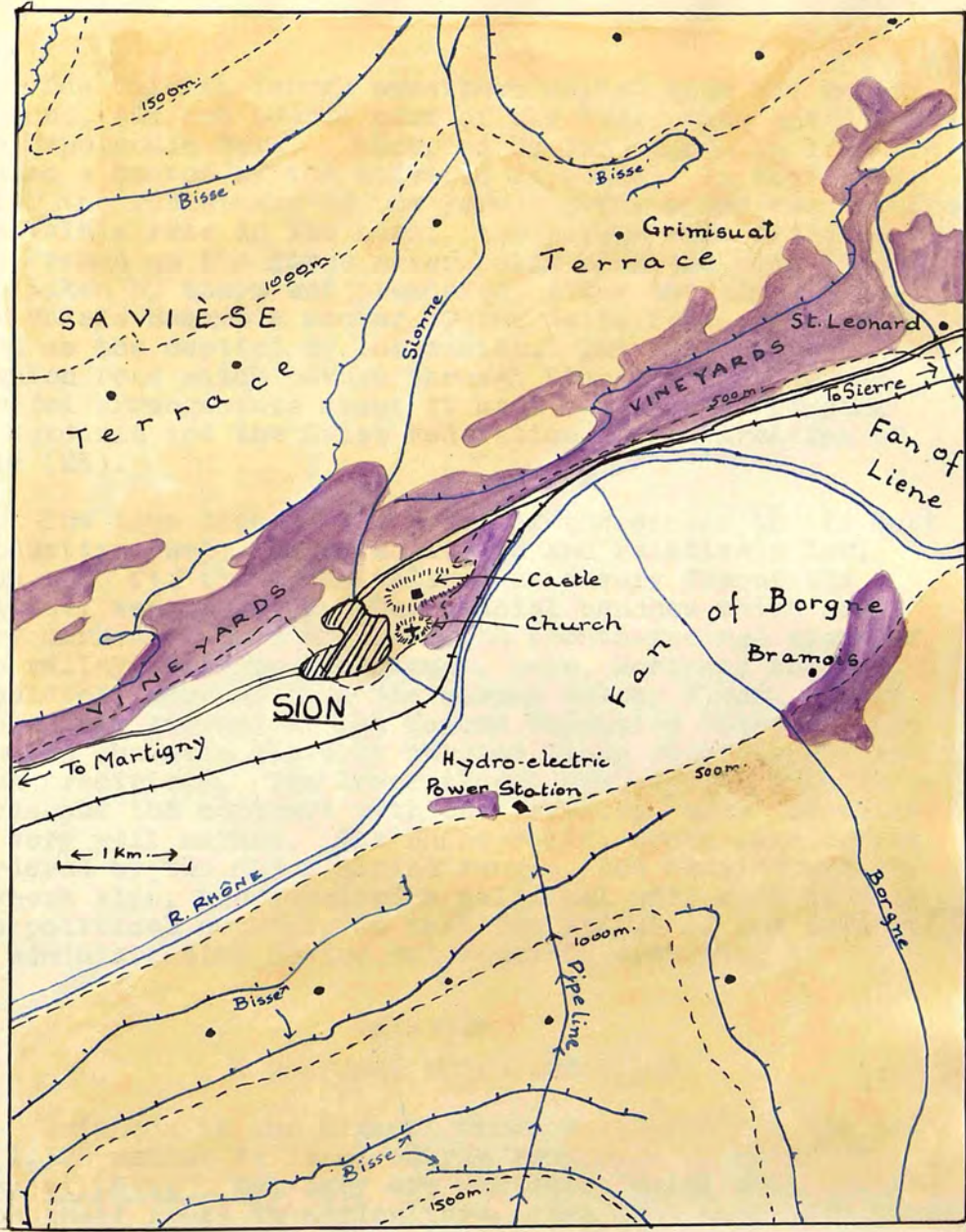


Figure 17. Position of Sion, Swiss Valais.

The Valais, though sometimes allied with the Swiss Cantons, did not become part of the Federation until after the Napoleonic Wars. Occupied by the French in 1798, it became a canton of the Helvetic Republic. In that year, after the resistance of the Forest Cantons had been crushed, the Valais rose in its turn. The people were defeated by the French on the Morge river below Sion and Sion itself was taken by storm and plundered. After the war, in 1815 the Valais became a member of the Swiss Federation, with Sion as the capital of the canton. The importance of the Simplon road which passed through Sion is shown by the careful arrangements about it made between the Kingdom of Sardinia and the Swiss Federation in the treaties of 1815 (25).

The town lies in the heart of the canton in its most productive part. Being sheltered and relatively low, (Sion, 500 ft.) the Rhône valley has a very favourable climate, warm and dry. The glacial benches which are a very marked feature of the north (south-facing) slope of the valley (Savièse, Grimisuat, Lens, Montana) are well populated, more so than the marshy valley floor. These slopes are watered by the famous Valaisian 'bisses', the minutes channels cleverly carried along steep slopes and even precipices. The lower slopes are covered with vineyards and the contrast with the forested 'ubac' opposite is very well marked. The Rhône valley above Lake Geneva, bordered by two major Alpine ranges, the Pennine and the Bernese Alps, has remained a political unit with Sion as its political capital, so that the status of the town as an administrative centre has remained constant.

BRIANÇON

A FORTRESS AT A CROSSROADS.

Briançon is the highest urban settlement in the Alps; at 1,326 metres it is of course surpassed in height by many villages, but they are basically rural settlements, with their roots in agriculture, even when they have blossomed as holiday resorts. Briançon is an urban centre based on defence and trade.

It is characteristic of glacial valleys that their longitudinal profile is irregular; frequently there are abrupt rocky steps, and the river may cut a minor gorge in such a place, leaving an abrupt rocky knob which commands

the valley. Briançon is placed on one such 'verrou' in the upper Durance valley (Figure 18), a block of hard calcareous conglomerate past which the river flows in a gorge. The road passes by on the side of the town away from the river, and the old town is in an excellent position to control this route, which crosses the Col du Montgenèvre (1850 m.) to Cesana in the Dora Riparia valley and goes down to Turin. The place was strongly defended; the old town is still surrounded by the fortifications built by Vauban. The higher spur jutting out into the valley opposite the town is crowned by the Fort des Trois Têtes; east of the town the road is commanded by the Fort des Salettes on a rocky promontory of the northern slopes and every spur and crest to the south-east of the town has its forts. The modern town has spilled out over the ramparts; it has advanced chiefly along the Grenoble road and down the Durance to link up with the hamlet of Ste. Catherine where the railway is situated; settlement has more room to spread out here than by the restricted site of the old town.

The site has more significance than that resulting from its control of the route over the Col du Montgenèvre, for Briançon is also a crossroads. Five valleys meet here, four of them with through road routes to-day (the fifth, the Clairée valley, has only a path over the Col d' Echelle into Italy); there is the Montgenèvre route to the east up the Durance valley; down the Durance road and rail traverse the narrow, frequently constricted valley to Gap and the Rhône valley, and through Provence to Marseilles. Northwards the Route des Alpes goes along the beautiful Guisane valley and climbs over the Col du Lautaret, skirting the edge of the Pelvoux massif, thence down the Romanche valley to Grenoble, or by a more difficult route via the Col du Galibier to the Arc valley and St. Jean de Maurienne. Lastly, south-east of the town the Route des Alpes climbs to the village of Cervières and from there crosses the Col d'Izoard through the fantastic rock forms of the Casse Déserte and thence via Barcelonnette to Nice, or over the Col de Larche into Italy.

The number of possible routes existing here in the midst of the high Alps is related to the structure of the Briançonnais which lies in the zone of Permian and Carboniferous rocks east of the crystalline Pelvoux massif. This zone has a very varied relief owing to differential erosion; the old limestones stand up as high and rugged peaks and

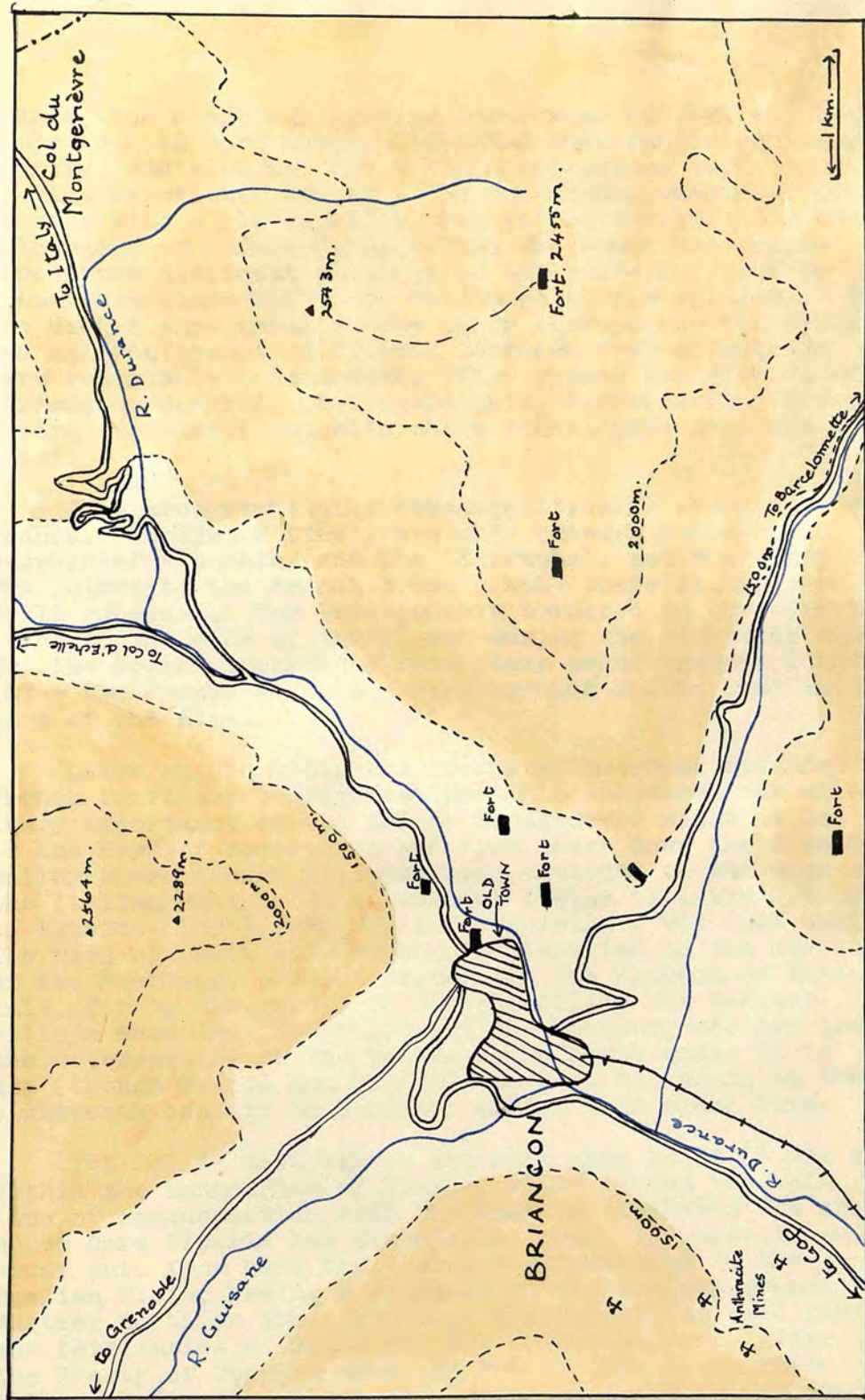


Figure 18. Briançon, Dauphiné, and the Montgenèvre Pass.

ridges, the clays and gypsums form broad valleys and the whole area is more deeply dissected than the crystalline massifs, and although the valleys and passes are high they provide negotiable routes. The Col du Montgènevre itself is easy with a plateau-like area at its summit; for the muletracks of former days, before the roads were engineered, the difficult sections of the route lay farther downstream where there are difficult narrow sections. In the Middle Ages these remote upper valleys on both sides of the main watershed, difficult to reach from downstream, were remarkable independent. They formed the five 'Écartons' (Briançon, Queyras, Château-Dauphin, Fenestrelles, Exilles), a sort of federal republic where feudal privilege did not exist.

This area eventually became politically associated with France. In 1343 a treaty was made between Humbert II, Dauphin of Viennois, and the 'Écartons', and when Dauphiné was joined to the French crown (1456) their rights were still retained. The Briançonnais bordered on the territories of the Duke of Savoy, and during the sixteenth century the French incursions into Italy under Francis I and later the French Religious Wars brought armies into this part of the Alps.

Later on, in 1631, the Treaty of Cherasco extended French territory to Pignerol and this increased the military importance of the Col du Montgènevre since it led to the Pass of Sestrières and from there down the Clusone valley where French territory now extended to the edge of the Italian Plain. This boundary lasted till the Treaty of Ryswick (1695) when the extra territory was lost again. The wars of Louis XIV eventually resulted in the division of the Écartons between France and the Kingdom of Sardinia, for by the Treaty of Utrecht (1713) the eastern valleys were lost to France and the boundary was set along the waterparting on the Col du Montgènevre where it is today (though France and Sardinia were at war again in the eighteenth century no boundary change took place here).

The Col du Montgènevre was much used while it was well within the boundaries of France, since it was the main line of communication with the eastern 'Écartons' in the upper Dora Riparia and Clusone valleys. If hostilities broke out, from here the French could descend to the Italian Plain, having a foothold on the Italian slopes. Farther north on the other hand the passes lay well inside the territories of Savoy and the Swiss Cantons. After the Treaty of Utrecht when the French lost the eastern valley heads, the importance of the Montgènevre route.

declined, and with it the importance of Briançon. The acquisition of Savoy in 1859 brought the French boundary up to the Mont Cenis Pass. Now this route is far more advantageous if journeying from Turin to Paris, for it leads by way of the Arc Valley directly to the Sub-Alpine Trench without crossing any more passes, whereas coming by Montgenèvre to Briançon, it is necessary to cross either the Col du Lautaret or the Col Bayard to reach Grenoble; the Durance valley leads south away from the heart of France. The first road was built over the Mont Cenis Pass, and later the railway tunnel was built under the Col de Fréjus. The railway reaches Briançon but does not continue into Italy. This puts it at a further disadvantage.

It was, then during the Middle Ages and the sixteenth and seventeenth centuries that the possibilities of the site of Briançon were most fully developed, when she was the most important town and route centre of the Briançonnais 'Écartons', situated astride the watershed as they were. With the improvement of communications and the growth of more powerful governments this area lost its isolation and became attached to the states controlling the lower parts of the valleys leading down from the Briançonnais. Finally the nineteenth century change of frontier and the development of railways combined to reduce its importance still further. Later improvements in road building have only partly restored its position as a focus of routes.

RONCESVALLES AND BURGUETE THE PASS OF IBAÑETA IN THE PYRENEES.

The Pyrenees differ from the Alps in that they have not had the same amount of traffic, military or commercial crossing them. The Puerto de Ibañeta (Pass of Roncevaux) is one of the lower passes and is of no great difficulty. It is not on the Franco-Spanish boundary, which here bends northwards, a reflection perhaps, of the fact that access on the Spanish side is easier with a gentle approach, giving the advantage for penetration down the steeper French slope. The relatively easy pass must have facilitated the existence of the mediaeval Kingdom of Navarre lying across the range.

The most well-known date associated with this pass is 778 when, after Charlemagne had captured Pamplona from the Moors, but had failed to take Zaragoza, he retreated through the pass, and his rearguard under the command of Roland was attacked and Roland was killed. Navarre became an independent Kingdom between France and Aragon; it was

united with Aragon from 1076 to 1134, and after a further period of independence its crown was united by marriage with that of France in 1284. Navarre was divided when Ferdinand of Aragon conquered all of it south of the Pyrenees in 1512. From the time of Charlemagne to that of Ferdinand the pass had not the strategic position near a boundary which it has now, but it was important for quite a different reason. During the Middle Ages Santiago de Compostella in Galicia was an important place of pilgrimage and the Puerto de Ibañeta was an important route for pilgrims coming from northern Europe. The settlement at the southern foot to the pass. Roncesvalles (952 m.) is associated with this traffic, not with defence. The great abbey there provided hospitality for the pilgrims. There is little there to-day besides the abbey, which has considerable tourist value, an hotel, and a small cluster of houses overlooking the plain of Burguete, above which the road climbs the western side of a small valley to the pass.

In modern times the pass did not play any important part in military affairs until the Peninsular War. In 1813 when the French under Marshall Soult were retreating after their defeat at Vitoria they were defeated again at the pass by Wellington. Since then no armies have faced each other across the Pyrenees.

Other villages south of the pass have been influenced by its existence. Burguete is a 'strassendorf' (Figure 6; Plate IVb) on the road to France from Pamplona. At 897 m. above the sea it gives little impression of height because it lies in a basin about two miles in diameter, the summits round it rising to 1100 to 1200 metres so that from the village they do not appear very high. The village lies on a slight ridge between the two streams which drain the basin and which have cut down into its floor; the ridge provides the best route for the road to cross the basin to the pass. The main road from Pamplona does not come up the Urrobi valley; it crosses the Puerto de Espinal from the Erro valley. The village of Espinal on this road was founded as a resting place for pilgrims; like Burguete and several other villages along this same pilgrims' road it is a 'strassendorf'.

These Pyrenean valleys of Navarre are, generally speaking, very isolated from each other, except in the east-west line just south of Burguete, as already explained in Section I (p.26 - 27); here the three valleys

of the Erro, Urrobi and Irati are in easy communication with each other, and the fortnightly market of Burguete in the most central position is frequented by the people of the two neighbouring valleys. There are also fairs in May, July and September. Thus Burguete has little business with the lower part of its own valley, but deals with those on either side helped by the structural feature which has provided a good transverse route. That the reasons for the growth of Burguete are multiple is plain from the fact that from its strategic position we have passed to its function as a market, and it has already been cited in the agricultural section. It is also a holiday resort, being cooler and fresher than Pamplona from which it is easily reached. Yet it is still only a big village because the trade is very localised and present-day traffic through the Puerto de Ibaneta is slight.

SECTION V.

HEALTH AND HOLIDAY RESORTS.

The final functional type of settlement is of much more recent growth than any of the others, excepting some industrial settlements. During most of human history man has feared the mountains and avoided them rather than sought their benefits to health (leaving aside the case of the Andes, whose settlement does not come into the classification being considered in this section), until the nineteenth century. In the last hundred years the dwellers in plains have increasingly visited mountains for their holidays and catering for them has become a recognised industry and an important source of income for the mountain folk.

In the first section the peculiarities of mountain climates were discussed from the point of view of agriculture. Certain points which were mentioned are particularly important in relation to the siting of holiday and health resorts. The most important is the fact that above 4,000 feet the liquid and solid impurities in the atmosphere have diminished considerably. At 8,000 feet one quarter of the mass of the atmosphere, half the atmospheric moisture and more than half the suspended dust are below. Therefore insolation is very intense and the ultra-violet rays are particularly powerful. On a clear day 75% of the total insolation will penetrate to 6,000 feet, but at sea-level only 50% will reach the earth's surface. In a smoky city still less will penetrate. On the heights the air temperature may be low but the sun's rays will be very powerful and may cause severe sunburn. In winter when the sun is at a low angle reflection from the snow-fields will still give an equally powerful effect. The heights have also this advantage in winter, that the sky is usually clear even when the valleys are clouded; in summer the reverse may be true and the peaks wrapped in cloud when the valleys are sunny. The humidity of the atmosphere is low and evaporation is high; in the climbing of high peaks this is a tribulation to mountaineers, since it causes intense thirst, but at moderate heights it adds to the delight of winter sports as clothes dry off quickly and it gives a feeling of exhilaration. The good effects of these mountain conditions on the lungs has given rise to many sanatoriums at suitable altitudes.

Saussure climbing Mont Blanc in the eighteenth century was an isolated figure, and had to have a scientific excuse for doing it; in 1865 Edward Whymper climbed the Matterhorn with no excuse except that it presented a challenge to him, but people were shocked that a noted cleric and a scion of the aristocracy should perish in such an enterprise; now-a-days peaks are hung with iron-mongery to aid the tourist or reached by funicular or cable railway. Thus in the last hundred years mountain scenery, instead of being regarded merely as alarming, has become an attraction to visitors and an economic asset to the local population. Its value has become such that to guard it for the future against the possible depredations of advancing settlement and industry it is preserved by the creation of national parks and nature reserves.

There is plenty of mountain scenery in the world; whether or not a particular area has developed a tourist industry depends largely on its accessibility as well as on the existence of especially famous local features. It is mainly developed in mountain areas accessible to large populations with a high standard of living, especially where there are industrialised and urban areas where people want to escape from the towns. Therefore its chief sites are located in Europe and in North America; it is also found in the Caucasus Mountains and in Argentina.

One country stands out above all and must be given special mention, that is to say, Switzerland. From end to end of the Alps the tourist industry is important but in Austria, Italy and France it has not been brought to quite such an art as in Switzerland. On the northern border of the Alps and easily reached across the Swiss plateau are Luzern and the Bernese Oberland resorts, Interlaken, Grindelwald, Meiringen, the Lauterbrunnen and Kander valleys. Equally easy to reach are Geneva, Lausanne and Montreux in the south-west of the country. More remote but with the attraction of the high peaks are the resorts in the valleys of the Pennine Alps, with Zermatt in the first place. Eastern Switzerland has the high valleys famous for their winter sports, St. Moritz, Arosa, Davos; the last named, at 5,120 feet, has a particularly good winter climate, and first as a health resort, then with winter sports, grew from a village of 1,700 people to a town of 10,000 in 70 years.

Switzerland's neighbours, France, Italy, Germany and Austria, have their own Alpine resorts, although visitors do come to Switzerland from those countries. Her amenities

are of more importance to the densely populated countries a little farther off which have no high mountains of their own, that is to say, Great Britain, Belgium and Holland. These have good rail communications with Switzerland, either by the Basle - Bern - Lötschberg - Simplon line or through Paris and Lausanne. Thus the control of transalpine routes which gave Switzerland such a good strategic position in European international trade has contributed not a little to the growth of her tourist industry.

France's most important mountain resort, Chamonix, owes its pre-eminence to its proximity to the Mont Blanc massif; there are many small resorts scattered in the valleys of Savoie and Dauphiné. The tirol, both the Austrian and the Italian parts, draw their visitors from north and south, from the plains of Germany and Italy, and from Britain as well, for whom in post-war years it has been cheaper than Switzerland, although farther away. Czechs and Poles have their resorts in the Tatra Mountains, for instance Zakopane in Poland, Štrbské Pleso in Slovakia. In Scandinavia the very emptiness of Norway's high fjelds becomes an advantage for tourism. The Pyrenees have their resorts on both flanks, in France (e.g. St. Jean-Pied-de-Port, Lourdes, Eaux-Bonnes, Cauterets, Bagnères -de-Luchon, etc.) and in Spain (e.g. Jaca, Puigcerda, La Molina, Nuria, Canfranc, the first being a summer resort, the last four winter sports centres). The Sierra de Guadarrama, within reach of Madrid, is described below; the Picos de Europa has already been mentioned in the Agricultural Section; tourism is little developed in Sapin's highest range, the Sierra Nevada. In Spain in general mountain resorts are much less developed than in the richer and more densely populated countries of western and central Europe. The varied relief of Europe, juxtaposing plains with rich agricultural and industrial resources and mountain ranges of considerable height, has given this continent by far the best conditions for the development of such resorts.

An example from North America, the Canadian Rockies resorts, is given below. Both the United States and Canada have an enormous amount of mountain scenery; the lower Appalachians are relatively near to the more densely populated parts of the continent but the high peaks and spectacular scenery of the Rockies, Sierra Nevada, Cascades, Selkirks and Coast Ranges are not accessible except where roads and railways pass through them and settlement of any kind is sparse. In South America, only in the southern Andes, in Argentina, can tourism be said to exist. New Zealand and Australia have their Alps, but with the small total populations of these countries, the corresponding mountain settlement is not extensive.

In tropical Asia a mountain resort of rather special character was developed. It resulted from the government of various Asiatic countries by white men who found the heat of the plains very trying in the hot season. So in India they went up to Darjeeling and Simla. In French Indochina Dalat in Cochin China stands at 1,500 m., in Tonkin, Tam-dao is at 900 m., Chapa at 1,800 m., Bokor at 1,000 metres. The Dutch in Java sought the relative coolness of Buitenzorg, Bandung and Garut; in the Philippines Baguio is set in the hills of Luzon, above the heat of the plains where Manila is situated.

Among the detailed examples given below are cited a variety of resorts, a typical Swiss resort, Grindelwald, where, with summer and winter visitors, catering for them has become the dominant activity of the village; Bardonecchia, a small but accessible Italian town where agriculture and tourism are still on more equal terms; the Sierra de Guadarrama with its special relation to Madrid; finally, in the New World, the purely touristic settlements of the Canadian Rockies.

GRINDELWALD.

SUMMER AND WINTER RESORT IN THE BERNESE OBERLAND.

North of the Rhone valley lies one of the major Alpine ranges, the Bernese Oberland. The highest peaks are in the south-eastern part of the range, which is composed of crystalline rocks; north of this lie the limestone Prealps. From the Jungfrau (4166 m.) to the Wetterhorn (3708 m.) the culminating peaks are right at the northern edge of the crystalline massif and it presents towards the north an immense and imposing wall of rock and glacier, at its fiercest in the north wall of the Eiger (3974 m.) which has cost many lives in the attempts to scale it. The wall is broken in two places, where the upper and lower Grindelwald glaciers extend down to 1300 m. This imposing array of mountain scenery and the easy access to the two glaciers has much to do with the importance of Grindelwald as a holiday resort. (Figure 19).

The village itself has no definite centre; its hotels and souvenir shops straggle along the road which runs along a steep slope at about 1037 metres. There is dispersed settlement all over this slope of the open basin of the upper part of the White Lutschine, which issues

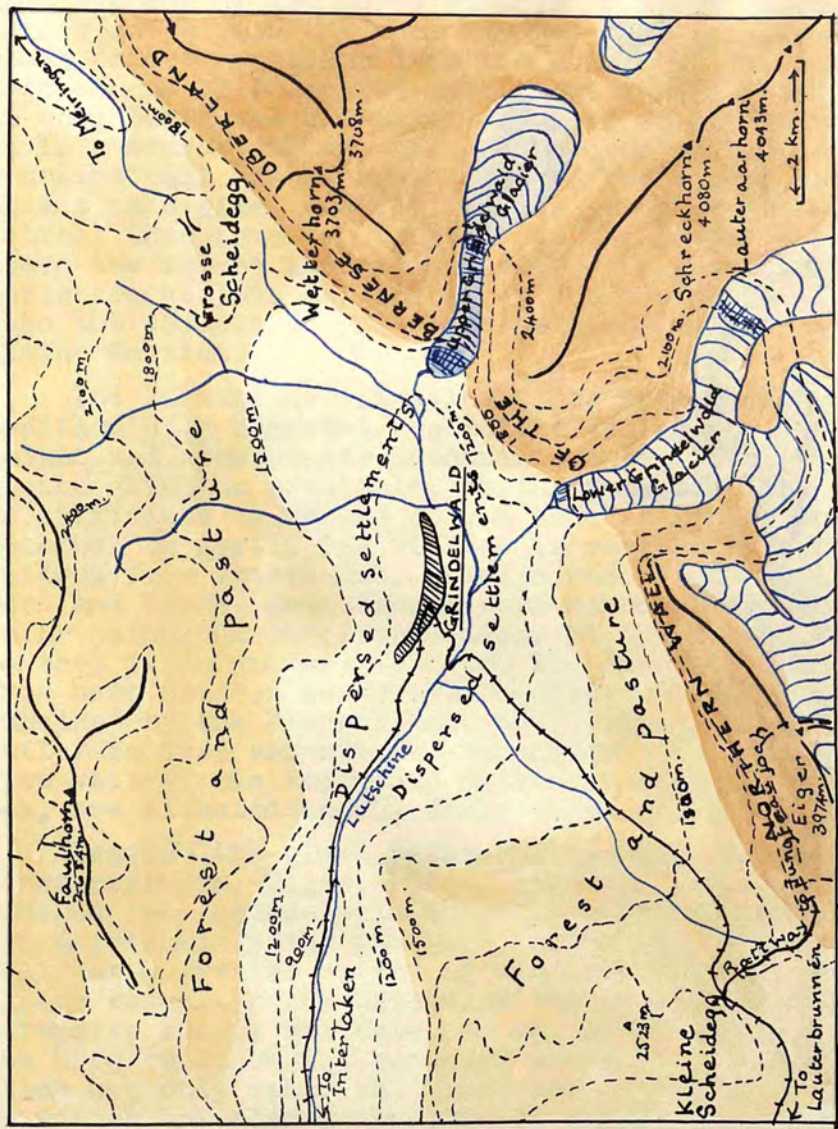


Figure 19. Position of Grindelwald, Bernese Alps.

from the end of the lower glacier, passing through a narrow gorge from which it emerges into boulder-filled woods before settling into its main bed. There is a certain amount of dispersed settlement on the ubac; in such an open basin the effect of exposure is not so marked as in a narrow valley, though the great height of the Oberland wall on the south side of the valley naturally shades that side. The settlements go up to about 1200 metres, then come the 'mayens' in the forest clearings and above the forest the alps extend up to about 2300 m., there are chalets at 2132 m. on the Hozmatten Alp; on the ubac the chalets do not go above 2,000 m. except on the Kleine Scheidegg.

The fortune of Grindelwald has been made by the juxtaposition of a pleasant accessible valley at a moderate height and spectacular mountain scenery with plenty of alpine climbing available. At the same time the height is sufficient to ensure enough snow in winter for skiing from December to April. The village is reached by a funicular railway from Interlaken, which is connected by rail with Bern and Basle. From Grindelwald moreover another funicular joins the Jungfrau Railway at the Kleine Scheidegg, so that it is as easy to reach the Jungfrauoch (3457 m.) from here as from Wengen in the Lauterbrunnen Valley (drained by the Black Lütschine). Since the Lauterbrunnen Valley is deep and narrow, in contrast to Grindelwald's open valley, its important holiday resorts, Wengen and Murren, are situated on the shelf above the glacial trough.

Besides the great peaks (Wetterhorn, Schreckhorn, Finsteraarhorn, Eiger, Mönch, Jungfrau) which can be reached from Grindelwald there is a wealth of glaciers for ski-touring; the Oberland, owing to its heavier rainfall has a greater extent of glaciers than any other Alpine range. In the Lütschine valley itself there are extensive slopes suitable for skiing and a chair-lift has been built on the northern slopes to 2100 metres, which not only makes the upper slopes accessible to skiers in winter but also to walkers in summer, enabling them to get more easily to the viewpoint of the Faulhorn (2684 m.) and to walk along the ridge to the Schynige Platte, from whence there is a funicular down to Interlaken. To the east the easy grassy pass of the Grosse scheidegg leads to Rosenlauri and Moiringen.

The agricultural activities of the valley, though by no means negligible, have definitely taken second place to the tourist trade; the dominance of the latter is

more possible in a valley which can cater for both summer and winter traffic, since the hotels can stay open all the year and guides can find employment at both seasons by acting as ski instructors during the winter. This resort has been well publicised, an important factor in the tourist traffic, which tends to flow in well defined channels.

BARDONECCHIA.

HOLIDAY RESORT THROUGH EASE OF ACCESS.

Bardonecchia (1312 metres) is situated at the Italian end of the Mt. Cenis Tunnel and the accessibility resulting from being on the main Paris - Rome railway line has altered the character of the town. There follows, first a description of its 'natural' situation, then of the changes due to the 'artificial' situation created by the piercing of the first of the great transalpine tunnels.

The little town lies in a small basin where five valleys meet (Figure 20); the basin, sloping gently to the south-east, is about one kilometre square and the old part of the town (Plate VIII b) is situated at the north-west corner, where the path from the Col de Frejus comes down, and where the exposure is most favourable. It lies between two streams, with the main street running down the centre and the church in a square of the west side. The streets are narrow and winding; the main street is just negotiable by a car (Plate VIII a). The two valleys behind the town rise steeply; that to the Col de Frejus is forested on both sides, but the forest is fairly open and there are a number of 'granges', the highest at 1927 m., from which the animals graze in the clearings and on the pastures above the forest. The other valley (leading to the Col de la Roue) is forested only on the north-facing slope (which is also very steep): the south-facing slope has extensive pastures of more moderate slope, and at the Granges de la Roue, a group of stone houses on a sunny shoulder, which are occupied for three months in the summer, barley, oats, potatoes and beans are grown (Plate VIII c). These are the two valleys most directly connected with the town, for the others have permanent villages of their own. The lower slopes facing south above the town are covered with small terraced fields. Though there are fruit trees in the sheltered gardens of the town, their general absence emphasises the height of this

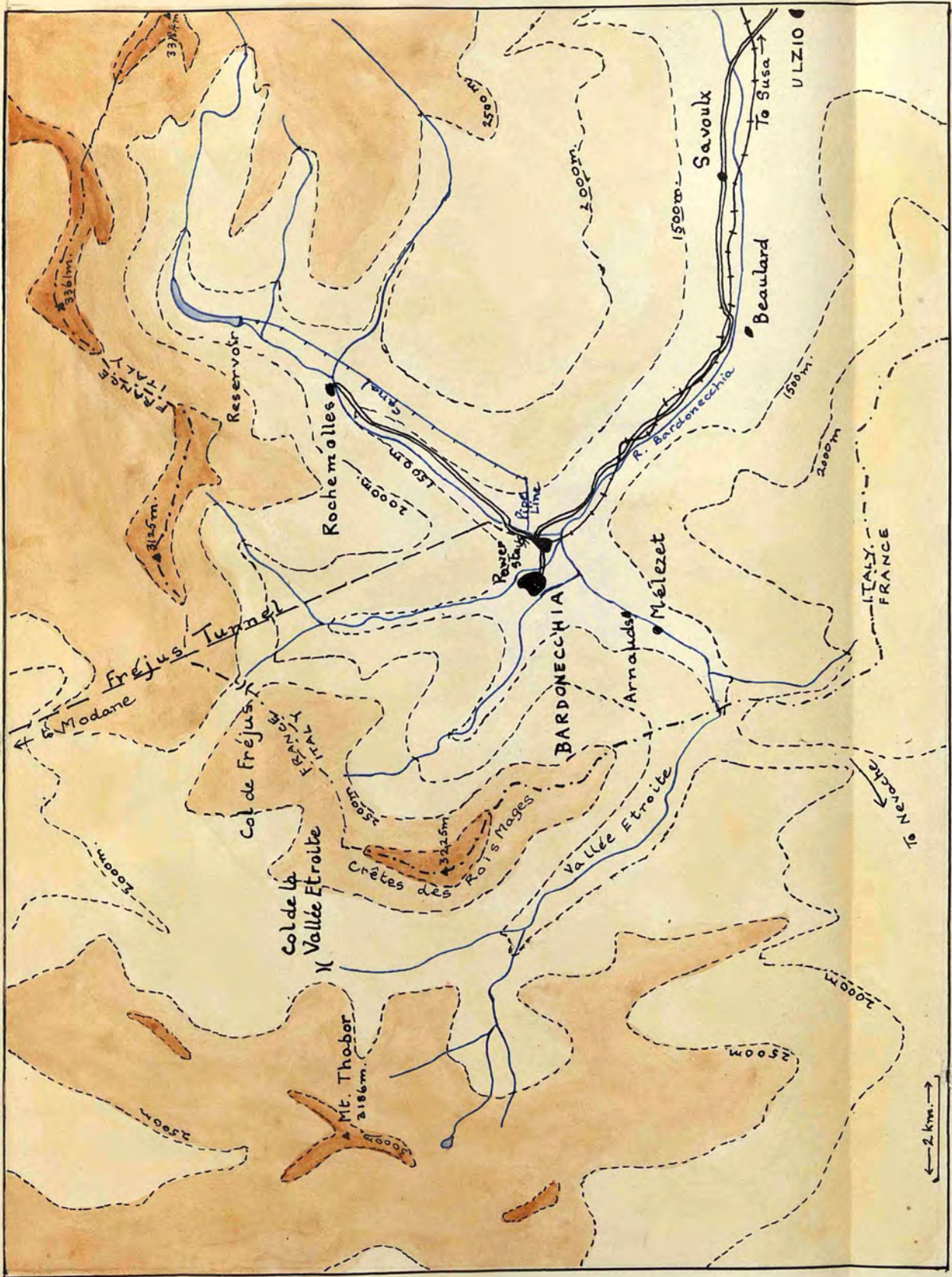


Figure 20. Bardonecchia, Italian Alps, and the Fréjus Tunnel.

PLATE VIII
BARDONECCHIA



a.

R.H.

a. Main street of the old town.



b.

R.H.

b. General view over the old town from the west.



c.

R.H.

D.G.

c. Granges de la Roue, Summer dwellings. Pasture and cultivation.

valley in comparison with the vine-clad slopes of the nearby Dora Riparia, into which this valley leads.

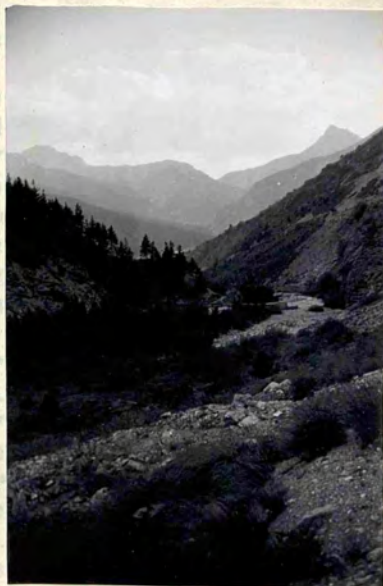
To the south-west is the Vallee Etroite, its lower part having the same trend as the Rochemolles valley described below, but above the villages of les Arnauds and Melezet the valley swings round the end of the ridge of the Cretes des Rois Mages, whose crumbling rock towers crown the great stretches of scree which reach right down on one side, cliffs on the other, confine the middle part of this valley, justifying its name. Higher up the floor of the valley widens out with open forest and pastures round a group of stone chalets. There are also extensive sheep pastures on the moraine-covered slopes below Mt. Thabor (3186 m.). These peaks round Bardonecchia do not carry permanent snow (with the exception of one or two 'wraiths') on the southern side though there are some small glaciers on the northern side. They are of characteristically rotten rock with the consequent great development of screes as described above. All of the Vallee Etroite above Melezet is now in France; before 1947 the frontier ran along the ridge of Mt. Thabor; now it runs along the Crete des Rois Mages.

The north-east valley has a deep and narrow defile in its lower section (Plate IXa); the north-west slope is very steep and often precipitous so that it is of little use despite its more favourable aspect; the south-east slope is forested. Four miles up the valley is the village of Rochemolles (1597 m.) it stands on a narrow sloping terrace a hundred feet or so above the stream and it is on the lower edge of an alluvial cone (Plate IXc) which provides the cultivable land in the valley. The steep slopes on either side are used for hay and pasture. Four or five hay lifts, each a single wire, transport the hay to the village; a large part of its ramshackle buildings consist of haybarns.

Not long before the war a dam was built above the village creating a reservoir in the upper part of the valley from which a tunnel carries water to feed a power station near the entrance to the Mt. Cenis Tunnel. A private cable railway runs up beside the pipeline and from its head a light railway parallels the aqueduct to the dam. The reservoir has flooded some of Rochemolles' summer pastures, but there are others in the tributary valleys on the east of the village.

PLATE IX
BARDONECCHIA

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a. U.C.

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ation with a number of hotels
state. Many weathered buildings
a. Looking down the valley below
Rochesmollés

a. Looking down the valley below
Rochesmollés

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Plain of
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b. Main street of Rochesmollés.



b. R.H.

sent plenty of variety of scenery
ridges are unexpectedly accessi-
ble; these were constructed in
distributions whose ruins are
also now covered in sufficient
a place; there is a ski lift on
own. The tourist traffic is
is a small number of foreign

c. Terraced fields on alluvial
fan above Rochesmollés.



c. R.H.

The fifth valley in the south-east leads down to Ulzio and Susa and carries the railway to Turin, also a motor road which at Ulzio meets the road coming from Cesana and the Montgenevre Pass. The existence of the railway is responsible for the growth of a new quarter of the town by the railway station with a number of hotels and cafes catering for tourists. Other scattered buildings have developed on the gentle wooded slopes leading down to the stream which comes from Melezet; there is a swimming pool there and a large holiday home for young children. There is also a rather pretentious community centre building dating from the Fascist era; part of it houses a youth hostel.

The five valleys present plenty of variety of scenery for walking; some of the ridges are unexpectedly accessible by easily graded paths; these were constructed to give access to the many fortifications whose ruins now crown the ridges. The winter snow cover is sufficient for winters sports to take place; there is a ski lift on the slopes south of the town. The tourist traffic is chiefly Italian, but there is a small number of foreign visitors. Since the Alps drop much more quickly to the Plain of Lombardy than they do to the lowlands on the north and west, this town, just below the major divide of this part of the Alps, is only $2\frac{1}{2}$ hours journey from the summer heat of Turin. While life in the old town flows on its agricultural way, the new town by the station, nearly as large as the old, and gradually creeping up the road towards it, hums with tourist activity and speaks potently of the influence of the modern routeway carried through the bowels of the mountain.

SIERRA DE GUADARRAMA

The Sierra de Guadarrama is one of the main ranges which break the monotony of the great Castilian plateau. The summits rise to 2430 metres (Penalara) above sea-level, but the plateau itself lies at nearly 1000 m. so that their apparent height is not so great (Figure 21). Nevertheless it is sufficient to produce a marked difference in temperature and vegetation. The mountains are for the most part covered with pine forests with some open rough pasture near the summits, some of which are rocky (e.g. Siete Picos and Penalara). There is no cultivation above the foothills. The range is easily reached from Madrid and has become a holiday area for the inhabitants of that

city; in summer it offers a refuge from the excessive heat of a markedly continental climate; in the correspondingly low temperatures of winter its snow cover provides the opportunity for the practice of winter sports.

The villages lie on the lower slopes where the mountains begin to rise from the plateau and the majority of those on the southern flanks of the range have become summer resorts (see Figure 22.) The most famous village is that of San Lorenzo del Escorial, only one hour from Madrid by electric train; its attraction lies in the great maonastery built by Philip II with its artistic treasures and historic interest. Though lower than many of the other villages it is sufficiently raised above Madrid's level to be appreciably cooler; it has several large hotels. A slightly higher and popular village is Cercedilla, one and a half hours journey from Madrid on the Segovia line (whose meandering course witnesses to the difficulty of railway construction in this as in all parts of Spain). It is situated at the entrance to two attractive wooded valleys and it is the junction for the mountain railway to the Pass of Navacerrada.

The Puerto de Navacerrada is the main skiing centre. There is no village here with an original agricultural basis as in the case of the summer resorts. The road from Madrid to La Granja (famous for its gardens) crosses the pass (1860 m.) and there is the electric railway from Cercedilla, which may however be blocked in winter, in which case it is necessary to ski from Cercedilla. The settlement is composed entirely of hotels and the like. Two hotels, an Alpine Club hostel represent the total. There is also a Falangist Youth centre and a workers' hostel, and an Alpine Club hostel a few miles farther on at Puerto de los Cotos, just below Penalara and near to the cirque lakes south of that peak. The area is also used as an army winter training ground. Thus the tourist, the skier and the youth organisation invade the territory of the shepherd and the woodcutter, because of the proximity of the capital city scorching in the summer in the midst of the bare brown empty Meseta, but with the tree-clad Sierra within sight to the north-west. This is primarily a localised tourist industry, an association between the one city and its neighbouring range, in contrast to the wider contacts of the major ranges such as the Pyrenees and the Alps. These lie near the main arteries of European transport and within reach of the great industrial agglomerations, whereas Madrid and the Guadarrama lie in the midst of one of the most thinly peopled parts of Europe.

TOURIST RESORTS IN THE CANADIAN ROCKIES (26)

It has already been emphasised that there is a marked difference between the high mountains of Europe and those of North America in that in the former any agricultural possibilities have usually been utilised, whereas the latter have relatively little agriculture, since neither pressure of population nor political strife nor climate have driven people to the mountains. Therefore the tourist industry has like the mining industry created its own settlements rather than causing modifications in existing agricultural settlements. The railway and the motor road have made possible the development of tourist resorts. Of course there is much grand scenery in these mountains which is accessible only to campers prepared to find their own trails through forested ranges where there is no permanent settlement of any kind.

The Rockies here are in three belts (Figure 22). The easternmost has westerly dipping strata; the centre, where the rocks are horizontally bedded, giving the mountains an aspect characteristic of this area, has the highest peaks and the most marked effects of glaciation; the western zone is lower with more tilted strata; it is also subject to a heavier rainfall and in consequence carries denser forest. In the National Parks Griffith Taylor distinguishes three classes of resorts. First, there are the major headquarters resorts, with big hotels and lodges with facilities for outfitting parties setting off on tours, serving as the trade centres for the recreational regions. These centres, that is to say, Jasper and Banff, are in the eastern zone. Their climate is milder than that of the 'objective' resorts referred to below, making a longer day out of doors possible, and making the summer longer. With a concentration of people there, a variety of recreations such as golf, tennis, swimming, dancing, riding, are catered for. These centres are on main railway lines, Banff on the Canadian Pacific, Jasper on the Canadian National line.

The second class consists of the 'objective' resorts situated at some particular landscape feature. These are nearly all in the Central Belt with its more magnificent scenery. A typical situation is at the outlet point of a small lake, possibly on a morainic barrier, which

(26) Griffith Taylor. Urgan Geography. London 1950.
p. 342 - 345.

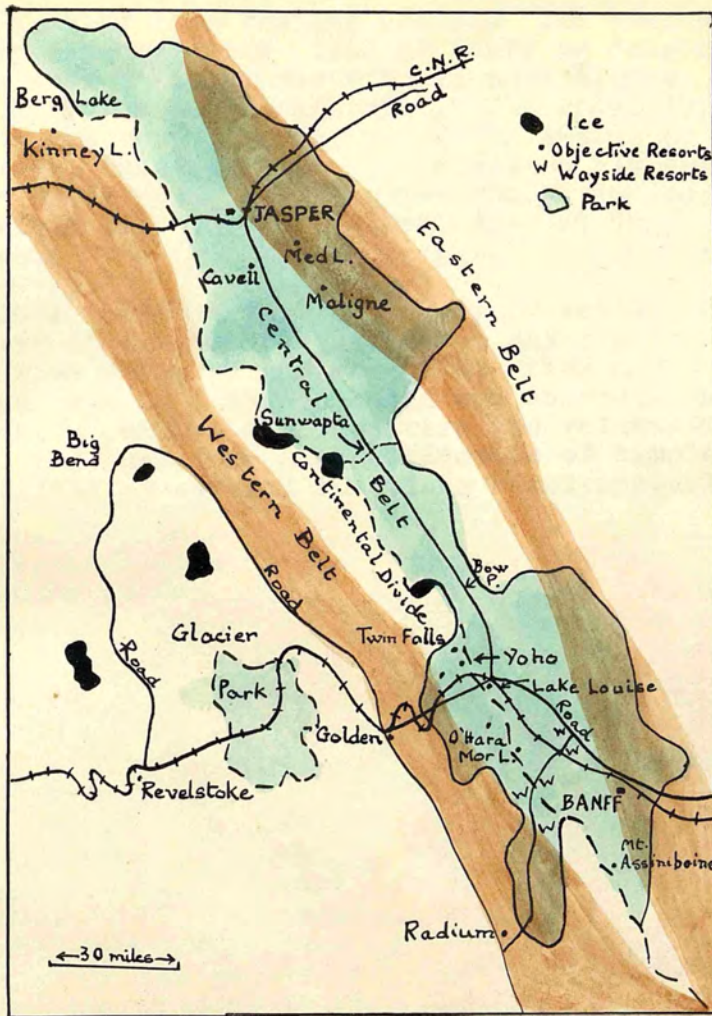


Figure 22. Canadian Rocky Mountains Resorts. (G. Taylor. Urban Geography).

gives a drier site for log cabins. The weather is usually less reliable than at Banff or Jasper; of course most of these resorts are much higher. Examples are Twin Falls and Lake Louise. The third type are the wayside resorts, offering food and lodging to passing motorists; these are usually near some picturesque canyon or bridge. The road from Banff to Jasper makes accessible the most magnificent scenery in North America.

These characteristic classes of resorts distinguished here are of course to be found in any regions with a tourist industry of any scale, but they are more clearly defined here in a region which has scarcely any other population (except for foresters and railway maintenance staff) and therefore has settlements of simple character, not fulfilling several functions simultaneously.

CONCLUSION.

Starting with the basis of a number of separate studies of mountain settlements visited at different times, common factors were sought by which the settlements might be classified. The type of information which had been gathered on these visits resulted in reflections on the way in which the physical setting of a place had influenced its character, as to whether it was chiefly concerned with agriculture, industry, trade, defence or recreation. These considerations on the places visited, and on others whose situation appeared to provide relevant material, have been dealt with in the course of this study. The aspect dealt with gives the whole study a deterministic flavour. This needs a little modification.

The reasons for the original entry of people into an area and its initial settlement may have no particularly geographical explanation. They might come up into the mountains to avoid unhealthy lowlands, but migration might just as likely result from population pressure or from a desire for safety from invaders. We are not concerned with this here; once in the mountains people chose sites for settlements, and although they exercised choice, they would be governed by common sense; if they were not, an agricultural village without sufficient land for cultivation and pasture would be the first to be abandoned, a mining settlement with inadequate resources would soon decay, a poorly defensible site would be destroyed by attack. If the possibilities are great, and population pressure is slight, freedom of choice is greater and the geographical necessities less stringent. Social traditions may dictate the choice of a dispersed or agglomerated settlement pattern; with a migrating people this may be carried from some different environment. On the other hand the pattern may have a definite geographical basis; appearances are easily deceptive, and though the social factors have not been mentioned except occasionally in the preceding studies, because they were by definition not concerned with them, caution has been exercised to try to avoid attributing facts to geographical influences when they might equally well result from others, not immediately apparent.

In Section IV, on strategic settlements, reference has been made to the changing historical value of settlements. This is particularly relevant to these towns with their political significance, but it applies with greater or less force to all settlements and particularly during the

last hundred years or so when economic development has been so rapid in many parts of the world. Since these changes are continuing to take place, it is important to weigh them and examine their effect on mountain towns and villages.

The locality of Bardonecchia in the western Italian Alps has already been considered in the last section and may serve as a starting point for this further consideration. Like the majority of mountain regions it has suffered considerable depopulation within the last hundred years and it is this development which is so significant. From 1871 to 1930 Bardonecchia lost 25% of her population (27). Within this period however fluctuations occur. The decrease was evident from 1871 to 1881 (3,098, 2,800) but by 1901 the figures show an increase (3,048) once again, which was maintained in 1911. The increase at the beginning of the century was associated with the electrification of the Modane - Turin railway through the Mt. Cenis (Frejus) Tunnel, and to local hydro-electrical works construction; after these operations were finished (after 1921) the decline in population re-asserted itself. In other words the economic opportunities again decreased and the area had difficulty in supporting the population, for though the density of population is low, there is pressure on the land if the population is considered in relation to the productive land. There used to be a considerable seasonal emigration into France to work there during the winter, involving not only the men but single women and married women without children, but between the wars this declined owing to the difficulty of getting passports on account of the political situation, and the flow of migration was perforce restricted to the direction of Turin and the Italian plains, and so more people left the district permanently.

It might be thought that the reduction in the number of people resident in the district would relax the pressure on the productive land. Actually this was not so. Although the land could not support the people without their winter emigration, the permanent emigration left too few to maintain cultivation at its former standard and this meant lower production. Yields also deteriorated because there were fewer animals and consequently less manure. This deterioration of the cultivated land is a common result

(27) Comitato per la Geografia del Consiglio Nazionale delle Ricerche. Publication VII. La spopolamento montano in Italia. I. Le Alpi Liguri-Piedmontiei. Vol. II. Milan Rome, 1932. p.47

of the widespread depopulation now evident, and where industries have developed which may help to maintain the numbers of the population, this only leads to a further desertion of the land. Fields go out of use and alps are no longer used because no one is available to look after the animals up there during the summer.

If smaller divisions are considered further details emerge. While Bardonecchia itself was enjoying its temporary increase of population at the beginning of the century, the smaller settlements continued to lose population steadily (that is, Hillaures, Melezet and Roachesmolles). All along the line, the smaller settlement was losing to the larger. One inhabited place, Vernets (1600 m.) was completely abandoned in 1917. Certain alps went out of use in the 1920's (all over 1900 m.); two of these above Rochesmölles were lost because they were inundated by the reservoir created for hydro-electric power. Thus settlement began to withdraw from the fringes; people moved from the higher to the lower parts of the commune, and from the commune as a whole eastwards down the valley.

Development of the tourist trade in Bardonecchia has been discussed in Section V. It is important to realise that while this has increased the size of the town, it has not had much effect on the native population or on their cultivation. For the most part the hotel staffs come from outside and they draw their supplies from outside, so that the catering community and the native community live side by side but separately, and as an agricultural settlement the decrease in size still holds good.

The whole question of depopulation turns on the matter of economic opportunities. While communications remained poor and industrial developments in the lowlands were only on a moderate scale, the mountain dweller continued in his isolation making what living he could out of a hard land. His position is different when road and railway have penetrated to within reach of his farm, and at the other end of them are factories offering work at wages which will enable him to enjoy a higher standard of living. It follows that the feature is most marked in areas within the sphere of influence of some large industrial centre such as Lyon. Take, for instance, a valley in the southern Jura, the Valromey (28). The conditions in this valley

(28) R. Lebeau. Les Possibilités de Modernisation de la vie rurale en Valromey, val-type de Jura meridional. Revue de Geog. de Lyon. 1952.

illustrate some of the disadvantages from which the emigrant mountaineer is trying to escape. This is a stock rearing region in which the settlement is in scattered hamlets, often cut off from each other by the gorges which dessect the basin and involve a difficult descent and ascent in crossing them. This created social difficulties; there is a lack of communal life. It is chiefly this lack which can be regarded as the cause of the depopulation, drawn by the not-so-distant towns of the Lyon industrial area. In the north of Valromey, the higher part, there were 23 farms, 200 people and 500 animals in 1840; in 1949 there were only 4 farms. This part had no road, no electricity, no priest, and snow lies for seven months of the year. By contrast, the village of Hotonnes, though also high, still has a numerous and flourishing population. But it has a carriage road, electricity, the telephone, and a school. If such amenities could be provided for more mountain settlements the drain of population might be diminished. Unfortunately the poverty of mountain areas itself makes it very difficult to do anything of the sort unless they are subsidised by an administration which controls richer areas as well which could provide capital.

Encouragement of the farmers who remain is also necessary, and improvements which will enable them to increase the productivity of their farms without requiring more manpower. In both Valromey and Bardonecchia, for instance, productivity would benefit from the regrouping of holdings, which are excessively subdivided and scattered, wasting the farmer's time in getting to them and difficult to manage economically because they are so small. This kind of action encounters the conservatism of the peasants, which hampers progress. Better breeding of animals, more careful management of pastures, prevention of soil erosion, irrigation, and the extension of co-operative dairying can help to improve production and lessen the waste of land which, though more difficult to farm than lowland, can be productive.

As far as agricultural settlements are concerned, then, they are declining generally, getting smaller in size, and the higher and more remote are gradually being abandoned. The presence of a population engaged in other occupations does not necessarily stimulate local food production because improved transport makes it easy to import food from other areas where it may be produced more cheaply. The depopulation is most noticeable in Europe where other

economic opportunities are available and railway and road nets have been developed. Another side of the picture is this; despite greater ease of movement the 'greater trans-humance' continues to decline. The chief reasons for this are the administrative and political controls which hamper long-distance movements, scientific methods of agriculture in which migrant animals are a nuisance, and the closer organisation of modern life.

Turning to mining and industrial settlements, the state of affairs is not so clearly defined as a matter of retreat or advance. It has already been shown that many former mining centres have had their day as the mineral resources were worked out, and have only survived at all if some other occupation had developed in the meantime to provide a livelihood for the population, which in any case probably declined in size. This will continue to be true of purely mining towns. Moreover there is a tendency for the average size of mining enterprises to increase that is to say, it is less than ever economic to engage in small mining ventures labouring under heavy transport costs, and heavy cost are as lethal to these settlements as exhaustion of their mineral deposits. Scientific discoveries and technical developments in industry make it difficult to forecast the future of mining towns, as the value of metals and fuels varies from time to time.

The possible lines of future industrial development have already been indicated. The old crafts which helped to supplement farming as a livelihood have already died or are dying, as their products are replaced by factory-made goods and as the people drift away to the towns. The water-power which sometimes aided these small industries is now increasingly employed for the production of electricity. Much of the power supplies industries in nearby lowlands but in some places, as has been shown in the study of the French Alps, considerable industrial development has taken place in the mountain valleys themselves. Development of this kind may be expected to continue, but in an age of large-scale planning much will depend on the economic policy of the authority controlling the region. If the tendency towards planning on an international scale continues in western Europe then the Alps will see a great deal more development, as already indicated in Section II. The policy of the Soviet Union, in encouraging greater self-sufficiency on the varied regions of that vast country, has increased industry in mountain regions, notably in Central Asia (in the Khirgiz and

Tadjik Republics). Development is constantly going on in the United States and Canada.

The most important modern development which has affected those towns that are chiefly concerned with trade of one kind or another is the improvement of communications and transport. This has had various effects, according to the particular local circumstances. One brings a recurrence of the tendency already noted, for larger settlements to gain at the expense of the smaller. When going to market involves travel on foot, or on muleback, or by slow oxcart, the sphere of influence of any market is limited and a number of small centres will flourish. When roads are built and a local bus service is run people can get to bigger centres which before they would have visited but rarely. In consequence the volume of trade dealt with there increases, while it decreases in all the small centres. This is true in Navarre, for instance, where places like Burguete, Arive and Erro have lost to Pamplona, for they have a daily bus service to the provincial capital.

A city such as Grenoble grows rapidly as improving methods of transport help to overcome difficulties of supply of raw materials of industry and distribution of products. As a regional capital it became more accessible from the valleys for which it is the focus. Moreover once a place is established as a route centre any new routes constructed in the area will tend to be focussed on it, even if some other site has equally good physical advantages but was not selected in the first place. So operates the old principle that to him that hath shall be given.

The building of railways through a mountain range affects the relative importance of places situated on that and other routes which may have been equally important previously. Thus a concentration of trade took place on the Alpine routes which were followed by railways. The position of the trans-continental lines in North America has strongly influenced the development of settlements in the Rockies and other ranges. Of course the early concentration caused by the development of certain routes is to some extent lessened as a more complete network of roads and railways grows up in a region as yet incompletely settled, where developing communications make possible a spreading out, as opposed to the drawing-in tendency in a region of old isolated settlements.

The effect of the improvement of communications on sites of strategic value has already been commented on. The development of air warfare and atomic weapons have so changed the character of modern war that mountain frontiers have decreased in value with consequent loss of importance for strategic points vital in ground fighting. Many well hidden fortifications along a valley route are of more value than one town surrounded by defences of the type constructed by Vauban. In local ground fighting of course landscape features retain their importance. But from the point of view of strategic settlement the impetus to its growth is removed. Mountains are more suited than lowlands to the concealment from air attack of vital factories, stores and headquarters constructed underground and from this point of view are valuable. As far as normal permanent settlement is concerned, however, this kind of thing is likely to have a discouraging effect, since a numerous population would be an embarrassment for reasons of security. Garrisons can be supplied from outside the area and stimulus to local food production will be lacking. In any case, to return to another point emphasised in Section IV, in any particular area the actual value of potentially strategic positions depends on the frontiers in force in any particular period, apart from the variations caused by contemporary methods of warfare. Whatever situation this may add up to in individual cases, modern strategic settlements are more artificial in character than those of past history, that is to say, they are not dependent on local supplies of food to the same extent.

Other permanent settlements are of course affected by the strategic developments which occur when frontiers are changing. No better example of a frontier region can be found than the Julian Alps through which runs the present Italo-Yugoslav boundary (Figure 23). This south-eastern end of the Alpine System and the Karst region to the south has been a frontier region all through history. It is a passageway with a number of passes leading from the North Italian Plain to the Pannonic Basin. The Romans advanced this way towards the Danube; barbarian tribes flowed through it from the east; later it became a contact zone between the powers of Austria and Venice (29). The Slovenes who inhabit it colonised the region in the seventh century, but took no part in the political and military struggles until the twentieth century. Their settlements are predominantly agricultural but they have been affected

(29) Moodie, A.E. The Italo-Yugoslav Boundary. London 1945.



Figure 23. Soča Valley, Slovenia, showing pre-war and postwar boundaries. Only those roads which affect the Soča valley are shown.

by the political vicissitudes of the region.

Consider the position and recent history of the settlements of the middle Soca (Isonzo) valley (Fig. 24). This section of the valley lies along the junction of the Alpine and Dinaric Mountain Systems, a line of weakness where the river has a wider valley than it has above Kobarid or below Most na Soci. This is an area of active erosion and slopes are steep but glaciation and post-glacial erosion have resulted in the formation of a series of terraces which can be utilised for agriculture. The valley trends northwest-southeast and aspect and relief give the more favourable sites on the north side. Ladra, Smast, Kamno, Volarje, Gabrje, Dolje, Zatoľmin, Zabce, Polubinj and the small town of Tolmin are all situated on these terraces. Usually the villages are situated at the upper limit of the terraces, or just above them, leaving the maximum area for cultivation. Higher up there are some villages sited on patches of moraine or on outcrops of impervious rocks. (Ravne, Jeserca, Dreznica, Vrsno, Krn). Krn for instance is a settlement of later date than those in the valley, probably a planina (alp) adopted as a permanent settlement. Transhumance is still active here and very important to conserve the valley land for crops. There is altogether a shortage of agricultural land and pressure of population. Though some are purely farmers, a great many have some other occupation as well, or members of their family have. They may find work in Tolmin, or farther afield in the industrial centre of Jesenice, coming home perhaps at the weekend. Younger member) of the family may migrate more permanently in search of better opportunities elsewhere. From 1931 to 1948 the population declined in most villages, a loss of up to 15%, rather more in some cases, especially in the higher villages (29).

Such a trend is typical of many mountain areas. The specific ways in which the frontier character of the region has affected the settlements and caused changes are three in number. First, actual destruction in war, second, strategic development of communications, third, alterations in contacts with neighbouring regions. In the First World War this stretch of valley and the heights to the north of it were in the front line where Austrians and Italians faced each other for over two years. Kobarid saw the catastrophe of the Italian army in 1916, whose remnants

(29) Zrimec, S. Geografski Vestnik. XXII 1950. Ljubljana, p. 61 - 94.

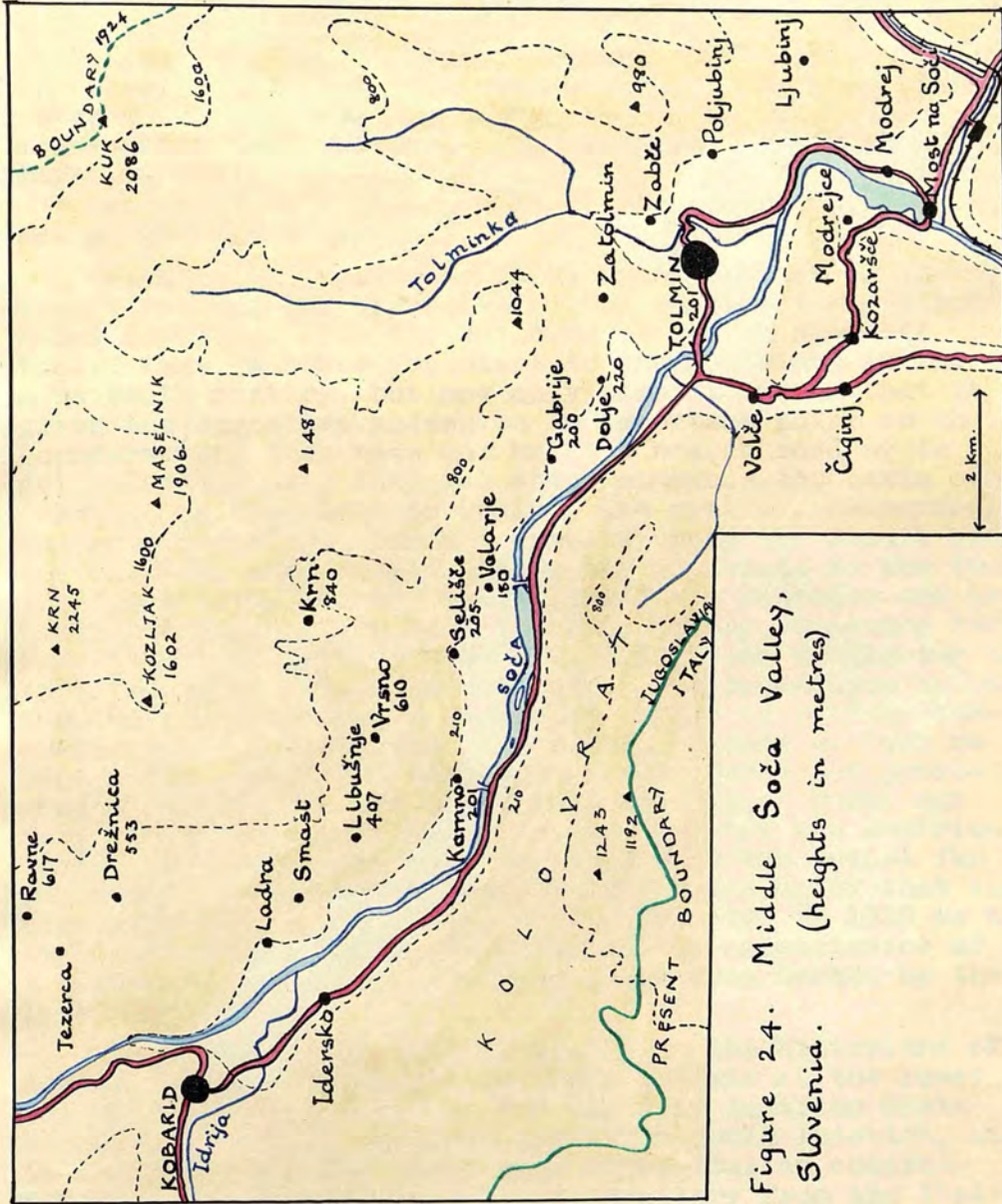


Figure 24. Middle Soča Valley, Slovenia. (heights in metres)

retreated westwards down the Nadiza valley, a route which then lay open for the Austrians to reach the plain at Civedale. All the villages suffered, some were almost completely destroyed, for example Volce, and were later rebuilt, so that few old houses are to be seen. Some destruction, on a minor scale, resulted from Partisan fighting during the Second World War. But the population are resilient, the villages as firmly rooted as ever, the new houses solidly built.

Already in Napoleonic times the influence of strategic considerations was operative in the construction of modern communications, with the building of a road over the Predil Pass, a route important to the Austrians in the nineteenth century, but now only significant in that it gives the Yugoslavs access to an important point on their boundary (and they have now built a branch road up to a col below the peak Mangart, which commands the basin of Tarvisio to the north in Italy). The railway, economically far more important, was not carried under the Predil Pass and down the Soca Valley, which lay too close to the frontier for safety, but was built (1848) via Jesenice and the Bohinj Tunnel, coming down the Baca valley, entering the Soca valley at Most na Soci (St. Lucia) and continuing down that valley to Gorica and Trieste. The upper Soca valley was therefore left up a backwater as far as railway communication was concerned, contacting it only at Most na Soci, which developed more commercially with its greater accessibility. On the other hand the region would not have had a railway at all so early, had not the Austrian desire to develop the port of Trieste as the outlet for the middle Danube basin dictated the building of that line. More recently, the shifting of the frontier in 1919 to the east side of the valley resulted in the maintenance of a good road up through the Soca gorge from Gorica by the Italians.

The Soca valley lies naturally in the hinterland of Gorica, which is situated in a small plain at the lower end of the Soca gorge. In the days of Austrian domination this natural economic direction could function, as it could between the World Wars under Italian control. But with the liberation of this territory from the Italians, and its inclusion in Yugoslavia after the Second World War, this was no longer so. The population of Gorica being mainly Italian the greater part of the town was given to Italy, Yugoslavia being left with a suburb

and control of the railway to Istria. Gorica has therefore lost her hinterland and the upper Soca valley her normal market. The wooded Brda, the dissected flysch country near Gorica with its hilltop villages and its vine and fruit growing was even more seriously bereft of its normal commercial connections. Politically, and to some extent economically, the valley has to turn eastwards over the watershed towards Ljubljana, capital of the Slovene Republic, with which she has a very round-about railway connection via Jesenice (an industrial centre which attracts surplus labour from the Julian valleys) and a more direct road connection through Cerkno or Idrija.

Here, where Mediterranean meets Alpine in type of climate, agriculture, houses, the human contacts dominate the Physical. The natural orientation of the valley is towards Italy, in so far that the Soca river flows in that direction. This must be qualified a little in that below Most na Soci the river passes through a gorge (but not a very severe one), whereas the Baca-Idrijca line continues the Kobarid-Tolmin depression eastwards. However though the Julian Alps do form a barrier it is a relatively low one with passes that can be crossed by mule tracks, and so the Slovenes spilled over the rim on to the Mediterranean side of the watershed. Modern communications have facilitated contact with the Sava basin still more. And now that the racial factor has determined the boundary the valley is partly orientated towards the east. The natural function of the site of Gorica has not been ignored all the same; it is expressed in the building of a new town, Nova Gorica, on the Yugoslav side of the boundary. One consideration for the future is that the Slovene Republic is more likely to promote the development of local industries (e.g. a needle factory has been established at Kobarid) than was the Italian administration; there is hydro-electric power from the Soca gorge where the river is dammed at Selo for the Doblar power station.

The release from the restriction of local self-sufficiency brought about by modern engineering and the internal combustion engine operated very clearly in the case of mountain resorts. These, depending for their livelihood on a sufficient flow of visitors, are closely tied to good communications. Railways are particularly important as they bring the majority of the holidaymakers. In crowded Europe new developments usually though not without exception affect some place where there is already a local agricultural population. In the American

continents on the other hand the reverse is true; it is more likely that tourist accommodation will precede other settlement since there is so much opportunity for it in still empty highland areas. This is so in part of Southern Chile and in Argentina in the Nahuel Huapi region, and of course in the National Parks of the USA and Canada. The increase of industrialisation and the accompanying rise in the standard of living are factors which tend to increase the proportion of people travelling away from home for their holidays to the seaside or the mountains.

To sum up, then, mountain settlements are likely to decrease in size and in number unless the standard of living and the social amenities and cultural opportunities can be improved to counteract the pull of the urban centres in the lower valleys and the lowlands. This pull, which is now so markedly operative in Europe, will become more evident in lands at present less forward in industrial development, as that type of development proceeds.

On the other hand there are extensive mountain regions where population is at present small in relation to the economic opportunities. This is true of parts of North America. It is also true of parts of Africa, for the reason that the African peoples, with some exceptions, do not take kindly to the mountains, which they are apt to people with vengeful spirits. Nevertheless, in view of the ever-growing problem of feeding the increasing population of the world, unused mountain regions may be utilised, if they can be safely used without destroying any value they have by initiating soil erosion. The mountains of New Zealand have suffered severe damage in this way from the introduction of sheep farming. Perhaps more Tennessee Valley Authorities are needed.

One thing is certain, nowhere are conditions likely to remain static; there will be changes of one kind or another taking place with far greater rapidity than in the past. Mountain regions as a whole are behindhand in the tendency for industrial and trading settlements to grow larger and to multiply more than agricultural settlements, but that influence is penetrating them more and more

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