THE

PRACTICAL TEACHING OF GEOGRAPHY

IN

SCHOOLS AND COLLEGES.

BY

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[This pamphlet, reprinted by permission, from "The Geographical Teacher," Vol II., No. 2, June, 1903, contains an account of the modern method of teaching the elements of Geography. The various subjects dealt with comprise, among others—Local Geography and Topography; Physical Geography, from the known to the unknown; Geography and Nature Study; Practical Geography, as map and plan drawing, contour lines, relief models, and the use of a map.]

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THE PRACTICAL TEACHING OF GEOGRAPHY IN SCHOOLS AND COLLEGES.*

THE teaching of geography begins in the nursery and infant-room. In childhood myths and fairy tales are the proper mental *pabulum*, just as they were in the infancy of the world. They are the nebulæ that in due time condense to form the realities of the workaday world. We ought to do nothing to dispel them, but, while the child still believes in them, we should encourage him to build the castles of the giants in sand or clay, and to draw plans, however crude, of the scenes and travels described.

The literature of no other country, perhaps, is so rich as ours in children's stories descriptive of places, journeys, and adventures, and nothing better than these could be found to awaken the interest of a child in geography. This idea of basing a child's first lessons in geography on his literary studies has been so excellently expressed by Prof. Ghisleri, of Cremona, that I am tempted to quote his words. He says that when a child comes to school

> the first month, or even two months, must be employed in telling stories calculated to stimulate the child, and to awaken his spontaneous curiosity. I would describe the great Polar ice-sheets, with their white bears; immense deserts, with their tribes of camels; tempests on the ocean; little Esquimaux pursuing the seals; tropical forests; Japanese or Chinamen with their curious customs; immense virgin forests of America; sudden avalanches which bury whole villages; countries where it never rains, and countries where it always rains; very high mountains with eternal snow; endless plains; volcanoes and earthquakes; and the adventures of bold explorers. I should illustrate these stories by pictures and examples extracted from well known works; for it is on the imagination that a good and fruitful teaching of geography must be based, and not on your topographical maps, on scales and projections. Now, consider how many things the pupil will have learnt almost unconsciously; how many true and beautiful and accurate notions will have been conveyed, and what valuable stores of curiosity and interest for every ulterior stage of his future study. All countries do not resemble each other, the child will reflect; there are hot and cold lands—some pleasant and some unpleasant, some rich and others poor. Now will be the moment for ascending from narrative to topography.†

* An address delivered to the members of the Aberdeen Branch of the Educational Institute of Scotland, and printed at their suggestion.

† From *The Teaching of Geography in Switzerland and North Italy*, by J. B. Reynolds (Cambridge University Press).

The connection between the teaching of geography and of literature was emphasized by Prof. S. S. Laurie in an address delivered to the Fellows of the Royal Scottish Geographical Society and reprinted in *The Training of Teachers and Methods of Instruction* (Cambridge University Press). This address contains an important statement of the educational principles underlying the teaching of geography.

But topography requires children to localize things, and this they cannot do without some notion of direction and distance. We should, therefore, teach them how to find the cardinal points from the position of the Sun at midday. In fact, we should lead them, by suitable questions, to observe during the day, and at different times of the year, the course of the Sun in the sky—where it rises, how it moves, and where it sets, so as to be able after a year or two to point with the finger the daily course of the Sun in summer and in winter. Teach them early to observe how, in consequence of the Sun's movement, the different sides of a house or street are illumined by the Sun at different hours of the day. Above all, make them able to trace with chalk a north and south line and an east and west one on the floor of the schoolroom, to tell the directions of objects in the room and outside of it, and the direction of the wind on that day. While they are being drilled require them occasionally to march in given directions; and so on.

When they can tell the relative directions of objects, let them next measure their distances—at first roughly as so many paces; and afterwards more exactly by means of the tape-line or yard-stick. When they have measured the lengths of the walls of the class-room by pacing, show them on the blackboard how to draw a plan of the room to a particular scale—say, an inch for each pace—and get them to draw it on a smaller scale on their slates or paper. Next draw on the blackboard a somewhat fuller plan of the room, showing the relative positions of the doors, windows, fireplace, and benches. Proceed similarly with the playground, school buildings, and the streets in the immediate neighbourhood of the school. Then show the pupils a large well executed plan of the school and its surroundings, correct in scale and orientation, but giving only the essential details, and question them upon it.

Next, *train them to estimate distances*—the length and breadth of the school desk, blackboard, &c., and the distance of the latter away, the width of a street, river, or valley, and the distance of a hill off, &c. This is an admirable training not only for immediate use in connection with the further teaching of geography, but also for after-life.

After this preliminary instruction, a series of excursions should be made to some neighbouring eminence, and an analysis made by the children of the landscape into its plains, hills, valleys, streams, rivers, ponds, lakes, woods, pasture and arable land, and the chief kinds of crops grown, the quarries and the mines, the centres of population and their means of communication. If the school be near the sea, the children will have an opportunity of observing the movements of the sea, and, perhaps, of discriminating bays, capes, peninsulas, isthmuses, islands, and straits.

All this would, as I have said, require a series of longer or shorter excursions *during school hours;* and, indeed, these outdoor lessons should be considered, as they are in other countries, a very important part of the school work. The children, after each outing, should be asked to write an account of what they observed. They should also be taught to make clay models of the natural features noted, and draw plans of them. If clay is not at hand, then moist sea-sand or foundry-sand (used for moulding) will answer the purpose, and the modelling should be done in old metal trays or in shallow flat pans about twenty inches by twelve.

A large and not very detailed physical map of the district should at this stage be placed before the class: for the children are now prepared to understand it, being able to compare it with what they have really seen. In subsequent walks and excursions the pupils should take simple hand-maps of the district with them, and compare the places immediately in view with the delineations of them in the map.

I have gone with considerable detail into this most elementary part of the teaching because not only is it important in itself, but it may be taken as a type of what the method of the whole of geographical instruction ought to be—always inductive, realistic, and practical. Moreover, the home district has to serve as a diagram in miniature of the wide world beyond, about which the children are so curious.

From the study of the visible region we should proceed to that of the places in close contact with it, and next to the study of the homeland—for "He who knows not his own country," says Goethe, "has no standard by which to know foreign lands." To give the pupils their first ideas of the structure of England (or Scotland) we should tell them that the general direction of the mountain-chains is north and south, with a long, gradual slope eastwards to the North Sea and a shorter slope westwards to the Atlantic, so that, if we could make a cutting across the country from sea to sea, the structure exposed might be very roughly represented* by Fig. 1. The rain that falls so plentifully in the

FIG. 1.

highlands runs down the two slopes, and carves them into river channels. (The rivers on which slope are likely to be the more useful, and why?) The river basins are the natural divisions of the country, and we should therefore begin by studying them, the mountains that separate them, the industries and chief towns in the basins, and why those industries and centres of population are located there. As this work is proceeding the teacher should draw an outline map on the blackboard, and fill in, as simply as possible, the rivers, mountains, and other natural features, in different colours; and only after a map has been gradually built up in this way should a wall-map of the country be shown to the class.

The other two divisions of the United Kingdom should be treated in a similar spirit. We should then proceed to the geography of the world as a whole, pointing out on a large globe—at least thirty inches in diameter—the relative positions of the oceans and continents. It should be explained to the children that each of the continents, except Africa and Australia, is divided into two slopes by an axis of mountains

* When the pupils have learned how to make sections along given straight lines in contoured maps (see page 14) they should be asked to draw sections along stated lines running east and west across the country, and thus correct the above crude representation of the general structure—sections, for instance, across Scotland, through Sutherlandshire, the Grampians, the Forth and Clyde Valleys, and the Southern Uplands would reveal very different structures. Similarly for England.

(not necessarily running north and south), just as explained for the home country, and that the configuration in these two exceptions is more like Fig. 2; that is, they consist of elevated plateaux in the interior and

FIG. 2.

mountain ranges not far from the coasts, with short rivers draining the slopes facing the oceans. While studying the general geography of each continent, the method of procedure should be similar to that already indicated.

Along with the elementary lessons in structural geography there should be going on concurrently a course of lessons in Nature Study. These lessons should not be too apparently systematic, either in their form of treatment or in their choice of subjects. The information should always be based on the direct observation of the pupils, and should be elicited from them by the questions of the teacher, who should make a note of the information obtained and read it in a connected form at the end of the lesson.

There should, for instance, frequently be short conversational lessons suggested by the weather and the changes of the seasons. On a wet day we might ask the following questions:—What is rain? Where does it come from? Where does it go to? What are its uses (especially to plants)? What is the colour of the sky on a wet day—on a dry day? How many kinds of clouds have you noticed? From what kind of cloud does a shower of rain fall?

In a similar spirit the first fall of snow, the frost on the windows, the ice on the skating-pond, and their subsequent disappearance might all be made the occasion of interesting conversations.

Water should be boiled in a beaker before the class, and the pupils asked to tell everything they observed. This would lead to simple explanations being given of invisible water vapour, the cloud of condensed vapour, and the three forms of water. Why did a white cloud form over the water as it boiled? How are clouds formed? Where do they get their water from?

By a series of lessons of this kind the children in course of time could be led to form a conception of the circulation of water through the earth and atmosphere—that "All the rivers run into the sea; yet the sea is not full; unto the place from whence the rivers come, thither they return again."

Winds—their direction, force and influence on temperature—would afford useful material for a number of talks with the children.

Again, the first green buds in spring, the first flower, the blossom on the fruit trees, the fall of the leaf in autumn, the first swallow, form abundant means of arousing the interest of the children in another aspect of Nature. To study the growth of plants, sow in a pot or box the seeds of some common annual such as mustard, and get the pupils to watch the changes during the growth and make coloured drawings of the buds and leaves as they appear. In order to observe the germination of seeds, mustard seeds or peas may be sown in wet sawdust and examined frequently, and drawings made of the growth of the roots. In excursions teach the children to distinguish the common trees by comparing their leaves and bark. Ask them to make drawings of the leaves and impressions of them on clay. Encourage them to draw the trees. Give simple lessons on the chief crops of the district. Observe soils in the excursions, and find the uses of the different kinds of soil.

From year to year a school diary should be kept, containing entries based on the reports of the children of the dates on which the common wild and garden flowers were first seen, when the buds or leaves of the different trees were first observed, the first and last appearance of the swallow for the season, when the cuckoo and curlew were first heard, &c. If this practice were more common among teachers, they would be surprised at how much it would help to develop the *habit* of observation in the pupils, and stimulate their interest in natural phenomena.

A word or two of warning regarding the method of carrying out a course of instruction like the above may be allowed:

In the first place, up to this stage no text-book either in geography or in Nature Study should be put into the hands of the children. Indeed, the teacher must be the book, directing the pupils by his skilful questioning and furnishing them with all the guidance and information necessary.

Again, in the whole of the geographical instruction our rule should be *multum, non multa.** We should not weary the children with minute details; for our aim is to supply them with materials from which to make clear and simple generalizations, and too many details would obstruct, if not entirely prevent, this process.

Finally, during the first survey of the home country and the world, only physical or structural maps† should be used; that is, maps shaded so as to indicate only the elevations and other surface features. The ordinary maps show everything on the flat, and therefore, to a beginner, do not suggest the reality. But their worst fault is the prominence they give to the political divisions. It should be our first aim to form in the minds of our pupils a clear concept of the Earth as a whole before we proceed to its artificial divisions, and we can only do this by making structural geography the basis of political geography.

Having stated so fully how the teaching of geography might be begun and carried on for three or four years, it will not be necessary to state with equal fulness how it should be taught during the remaining period of school-life. Just as it was the aim of the preliminary course to collect mental material, so the next and more strictly scientific course should have for its purpose to elicit from the pupils explanations of the causes of the phenomena already dealt with and the connections between them—in short, to add to the material that has been collected and form it into an organic body of knowledge.

* In the words of Roger Bacon, *Superfluitas impedit multum . . . et reddit opus abominabile.*

† Wall-maps of this kind are, unfortunately, not common in this country. Indeed, the only ones known to the writer are the recently issued *Physical School-room Maps*, by Messrs. George Philip & Son, which are based on the famous German maps of Habenicht and Sydow.

During this more advanced part of the geographical instruction we should not aim at so detailed a knowledge as is at present too frequently attempted. So far as mere memory work is concerned, we should be content with a knowledge of such facts as we may hope that the children will be able to carry with them as part of their mental equipment for life. Thus, a pupil leaving a higher-grade or secondary school* should have a *general* knowledge of:

1. THE HOME DISTRICT.—Its physical features and distribution of water, and how they have been influenced by the geological structure of the rocks. Distribution of arable and pastoral land. The climatic phenomena of the locality and their causes. Effects of all the foregoing on the natural products, industries, and commerce of the district. How all these influences have determined the distribution of the population and the position of the towns.

2. THE BRITISH ISLANDS.—The physical features, and, by comparing them with a geological map, to find out how the latter helps to explain the configuration. Natural products, commerce, fisheries, pastoral, agricultural, and mineral industries, and the chief manufactures. The counties, and the positions of the chief towns (in England we might take only the towns having more than 40,000 or 50,000 inhabitants). The main lines of railway and the chief stopping-places on them.

3. EUROPE.—Physical features generally. The countries and their capitals, and the positions of the towns having, say, over 100,000 inhabitants. The characteristic products and industries of the countries. The lines of railway connecting the capitals with each other and with the seaports.

4. THE WORLD.—Positions of the continents, oceans, and groups of islands. The political divisions and their capitals. The positions of the most important towns and seaports. The great trunk lines connecting the countries. More detailed study of the British colonies on the different continents. Their industrial relations with the mother country.

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* Pupils leaving primary schools two or three years younger should, of course, know proportionately less, but the above are the general outlines on which we think their instruction should be based. The summary does not give the subjects in the precise order in which they should be taught. For example, a considerable part of Nos. 5, 6, and 7 should be taught before the political and economic geography of the world.

all these have been influenced by physical causes and contact with other nations.

Suggestions as to Practical Work in Geography for the Older Pupils in Schools.

At the present time, in almost all our schools, the only practical work in geography done by the pupils consists in copying occasionally a more or less elaborate map at home, or, less frequently, in school. Now, as it is not our object to train the children to become cartographers, the many hours spent by them in these mechanical exercises are mostly wasted—and, indeed, worse than wasted, for the practice does positive harm by compelling the children to think too much about the map and too little about the real landscape it represents. What we must train the children to do is not to copy at second-hand from maps, but to draw at first-hand from Nature. After they have learned in this way the meaning of maps and how to construct them, no harm will be done by requiring them to copy or reproduce simple maps.

Any thoughtful teacher who conscientiously prepares his work will have little difficulty in devising suitable practical exercises for the pupils during the later part of their studies in geography. The following are a few that have been found by the writer of this paper to interest his students and yield good results :—

1. To draw a Line in the direction of Geographical North and South, and another in the direction of Magnetic North and South, and thus find the Angle between them.— This can best be done out of doors. Choose a level part of the playground, and there support a pole by means of two pieces of wood joined so as to form an X, as in Fig. 3. The pole should be about seven feet

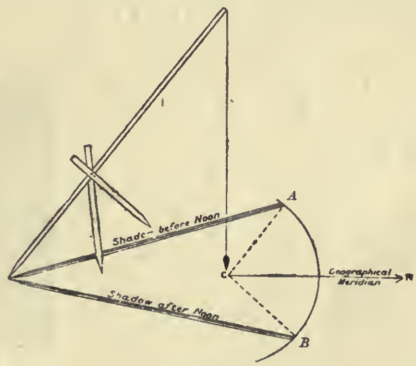


Fig. 3.

long, and placed so as to point roughly towards the north. From the end of the pole suspend a plumb-line. Make the class observe the position of the shadow, say, at 11 a.m., and stretch a string from the point *C* on the ground immediately below the plumb-line, and by means of a nail attached by trial at the proper distance along the string describe an arc of a circle to pass through the end *A* of the shadow of the pole. Bring the children back at 12 o'clock to observe that the shadow no longer reaches the circle, and about 1 o'clock get them to mark the point *B* at which the shadow again reaches the circle. Draw *AC* and

BC, and bisect the angle between them, and thus obtain a part of the geographical meridian. Next place a compass-needle with its centre over *C*, and draw on the ground a line in the direction of the axis of the needle. This represents a part of the magnetic meridian, the angle between which and the geographical meridian can now be measured on the ground by means of a protractor.

This exercise may be performed indoors by fixing, say, a penholder vertically by pushing the pen-point into the window-sill or into a horizontal board, as shown in Fig. 4. Then, with the foot *C* of the

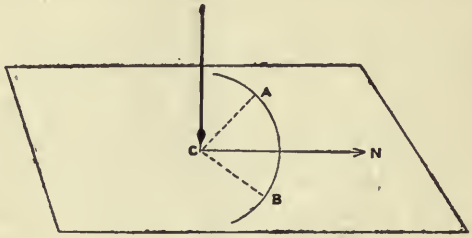


FIG. 4.

penholder as centre, describe a circle to pass through the end *A* of the shadow any time before noon, and observe the point *B* at which the shadow again reaches the circle, and bisect the angle *ACB* as before.

Recommend the pupils to try the following rule for finding roughly the meridian by means of a watch:—Hold the watch horizontally so that the hour-hand points towards the Sun; then the direction of the meridian is approximately midway between the hour-hand and the "XII" on the dial of the watch (see Fig. 5).

FIG. 5.

FIG. 6.

The children should also be told how to know their bearings at night by finding the position of the Pole Star by means of the Pointers of the Plough (Fig. 6).

2. TO DRAW A PLAN OF THE SCHOOL-ROOM CORRECT IN SCALE AND ORIENTATION.—The cardinal points should be clearly marked on the drawing; also, in all such exercises the pupils should not be allowed to rest content with merely stating the scale, but be required always to draw it.

3. TO DRAW A PLAN OF THE SCHOOL AND ITS ENVIRONS.—

The necessary measurements should be made by pacing, and the cardinal points obtained from the position of the Sun.

4. TO SKETCH, WITHOUT SURVEYING INSTRUMENTS, A PLAN OF WHAT IS SEEN FROM A NEIGHBOURING EMINENCE.—What is wanted here is not a map such as one finds in a Postal Directory, but a sort of bird's-eye view of the district, showing the relative positions and distances of the chief objects seen and the roads connecting them. Of course, the cardinal points should be indicated. This exercise will prepare the pupils for the next one, by making them feel the need of instruments to enable them especially to fix the positions of the objects accurately.

5. TO MAKE A MAP OF A DISTRICT BY MEANS OF THE PLANE-TABLE.—Experience has convinced the writer that of all instruments for determining the directions of objects the plane-table is the one best suited for school purposes. It is not much used in this country, but the surveys of India and the United States were carried out chiefly by means of it. In its ordinary form it costs at least £3, but one suitable in every respect for schools can be obtained for less than a third of that sum, by utilizing a camera tripod as the support and pivoting on the top of it a drawing-

FIG. 7.

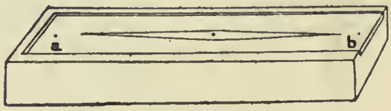


FIG. 8.

board, say, 20″ by 15½″ (Fig. 7).* Using instruments of this description, the writer each year got his students to construct a map of a certain district. One year they made a map of the district shown in Fig. 10. The plane-tables were set up at Station I. and levelled (there was a little circular spirit-level sunk near the edge of each board), and then clamped. Next, drawing-paper was pinned on each board and a line in the direction of magnetic north and south drawn on it. For this purpose a part of the equipment consisted of a little rectangular box (Fig. 8), inside which was a compass-needle supported on an upright brass pivot. The box was covered by a strip of glass or clear mica, which could be slid into position. The instrument was placed on the paper and then turned round till the needle lay exactly between the two points *a* and *b* in the central line of the base of the box; and when this was the case the axis of the needle was parallel

* The pieces of apparatus described in this paper can be obtained from A. H. Baird, instrument maker, Lothian Street, Edinburgh.

to the edge of the box, along which, therefore, a magnetic north and south line was ruled on the paper.

A sighting ruler was also required for each plane-table. This consisted of a ruler about a foot long, which had sights *A* and *B* (Fig. 9)

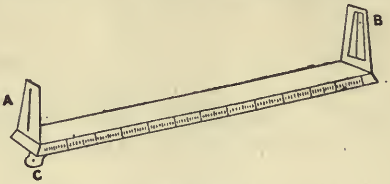


FIG. 9.

hinged at each end. The ruler could be pivoted at any point of the paper by passing a pin through a small hole in a piece of metal *C*, the hole being in line with the edge of the ruler. A line could then be drawn in the direction of any object by erecting the sights and turning the ruler horizontally till, on looking through a narrow vertical slit in *A*, the object could be seen coinciding with a thin vertical piece of metal in the centre of *B*. When this was the case a line was drawn along the edge of the ruler from *C* towards the object.

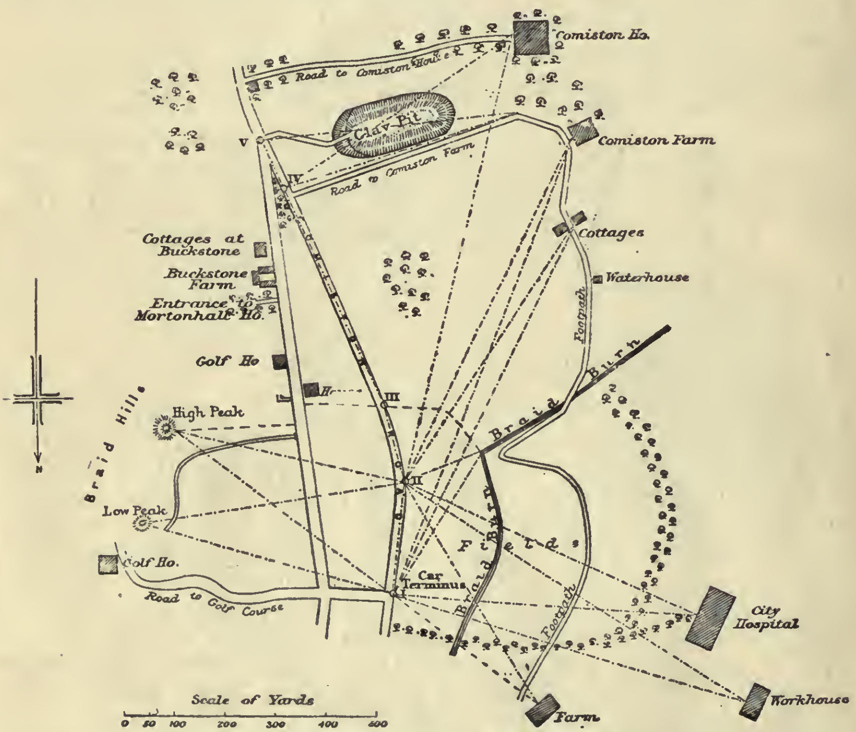


FIG. 10.—Some of the triangles in this map have their vertical angles too small. This defect should be avoided by taking the bearings of the distant objects from stations farther apart.

Having drawn lines in the directions of visible objects, we next required to represent the distances of the objects by measuring off lengths along these lines proportional to the distances. Hence there was a scale marked along the bevelled edge of the ruler. The smallest divisions of the scale were one-sixteenth of an inch apart: and taking these to represent each ten yards, the scale of the drawing was one-sixteenth of an inch for ten yards, or one inch for a hundred and sixty yards, or eleven inches to the mile—a very convenient scale when mapping a small area.

In mapping the district represented in Fig. 10 (which is a reproduction on a small scale of a drawing by one of the students) the sighting ruler was pivoted at the point marked Station I., and then the chimney of a farm, the tower of the Workhouse, the chimney of the City Hospital, and the bend of the Braid Burn were in turn sighted on the right, and lines drawn towards them; and, on the left, lines in the direction of two peaks of the Braid Hills were similarly drawn. Also a pole erected at Station II. was sighted, and, having measured the distance from I. to II. by means of the tape-line, the corresponding distance was measured off on the paper by the scale. This fixed the position of Station II. on the map, and the slightly curved right-hand edge of the road joining the two stations was then drawn by freehand. Having determined the width of the road, the corresponding part of the left-hand edge of the road was drawn.

The plane-table was now removed to Station II., and the board levelled and got into position by pivoting the ruler at II. and laying it along the line from II. to I., and then turning the board round horizontally till a post at Station I. was sighted. The board was then clamped, and the same objects sighted as before, and lines drawn towards them. The intersections of the two sets of dotted lines fixed on the map the positions of the six objects named above. Other objects visible from II. were also sighted, and lines drawn to them, and also to Station III. Having measured off the distance from II. to III., the plane-table was removed to Station III. and the same method of procedure followed as at Station II.

In this way we went on surveying for a distance of about three-quarters of a mile along one road, and back along another—the straight one in the map—to the starting point. On the first day we did nothing more than fix the positions of the chief points on the map. At a second visit to the district we filled in the details, such as the boundaries of the fields, the course of the stream, the outlines of the woods, &c., estimating distances when necessary by means of the positions already fixed on the map.

For work of this kind one plane-table to each four pupils is sufficient, and a teacher cannot thoroughly superintend the work of more than four plane-tables or sixteen pupils. It is absolutely necessary that the teacher should make a careful preliminary survey of the district about to be mapped, in order to select the most suitable stations, measure the distances between them, and make a note of the features to be observed at each station.

Experience has convinced the writer that elementary surveying or map-making such as has just been described would form a valuable piece of instruction in the higher classes in our schools, and would give the pupils a more thorough comprehension of the manner in which maps are made and surveys are conducted than they could possibly get in any other way.

6. To Make a Drawing of the Contour Lines at Vertical Intervals of, say, 10 feet along a Slope.—It is very difficult to represent on a flat map the inequalities of the Earth's surface. Up to the present time more than eighty different methods of indicating elevations have been suggested. The best of these devices is contour lines, and the teacher should carefully explain their meaning to the pupils. Suppose the shaded line in Fig. 11 to represent the slope to be contoured,

Fig. 11.

and that we wish to draw the shape of the horizontal line on its surface passing through *B*, 10 feet vertically below the starting point *A*, and, next, the shape of the horizontal line passing through *D* on its surface 10 feet vertically below *B*, and so on. Now it is evident that the distance *AB* depends on the inclination of the slope to the horizontal, for the steeper the slope the less the distance we shall have to travel down it in order to reach a point 10 feet vertically lower than the point from which we started. In fact, if we know the angle the slope makes with the horizontal, then we can tell the distance *AB*, and this is given in the second column of the table* on page 14. We evidently, therefore, require some means of determining what this angle is, and the instrument used for this purpose is called a clinometer. An inexpensive and sufficiently reliable one is shown in Fig. 12. It consists of a rectangular piece of wood, on which is glued half of a graduated circle used for galvanometers. At the centre of the semicircle is freely pivoted a metal arm with a weight at its other end, so that they together act as a plumb-line. The divisions on the card read from 0° at its lowest part up to 90° on each side. If the upper edge *PQ* of the wood is held horizontally, then the movable arm points to 0° on the card; and, if the upper edge is inclined, say, 12° to the horizontal, the arm will point to 12° on the circle. In other words, the reading on the circle always gives the inclination of the upper edge *PQ* to the horizontal.

Equipped with an instrument of this kind, a tape-line, and three

* This table should be compiled from the results obtained by the class collectively, by getting each pupil to find, say, six of the results in the second column, and an equal number in the third, by drawing *AC* (Fig. 11) to represent 10 feet to any scale, and drawing *CB* horizontal and *AB* inclined respectively, 1°, 2°, 3°, &c., to the horizon, and then finding the lengths represented by *AB* and *BC* respectively in their drawings.

surveying poles we can draw a representation of the contour lines as follows:—Stick one of the poles into the ground at the top of the slope and another at the bottom to mark the line (carefully chosen) along which we wish to work. Take the third pole and fold a sheet of paper so as to be about an inch wide, and fasten this with a drawing-pin on the part of the pole at the level of the eye, but leave an end of the paper projecting an inch or so from the pole for purposes of observation. Erect this pole as far down the slope as the inclination seems fairly uniform. Then apply the clinometer to the eye and incline the instrument till, on looking along the edge *PQ* (Fig. 12) the paper on the intermediate post is seen.

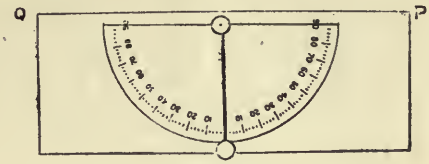


FIG. 12.

Note the division of the semicircle to which the plumb-line is pointing —this is the inclination of the slope to the horizon. Suppose it turns out 13°; then the table on page 14 tells us that we have to proceed 44·5 feet down the hill in order to be 10 feet vertically below the starting point *A* (Fig. 11). With the tape-line we measure off this distance, and take up our position at the point *B* obtained. But on the map we represent everything on the flat; that is, we draw on it not *AB*, but *CB*, which is less than *AB*, and will, of course, depend upon the inclination, as is shown in the third column of the table. In the case we have supposed, *CB* would be 14 yards. We therefore draw, on whatever scale* we adopt, a line *ab* (Fig. 13) to represent 14 yards. Then, while standing

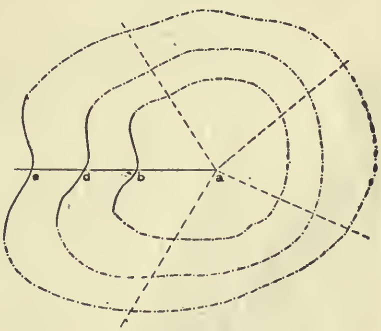


FIG. 13.

at *B* (Fig. 11), we observe the shape of the line on the ground at the same level as ourselves, and draw a line of this shape through *b* (Fig. 13), as indicated by the undotted part of the curve. Then from *B* we proceed to measure the inclination, &c., just as we did from *A*, and so on

* It had better be a large one. I found 110 inches to the mile a convenient one, so that each small division of the graduated scale on the sighting-rulers represented 1 yard, and not 10 yards, as before.

till we reach the bottom of the slope, and thus get the succession of contours depicted by the undotted curves in Fig. 13.

By contouring in this manner along a number of suitable directions (represented by the dotted straight lines in Fig. 13) from the top of the hill to its base, the contour lines at the same elevation on the different rays will run together and become continuous, like the dotted curves: and thus we get a complete representation of the contour lines of the hill.

DATA FOR DRAWING CONTOUR LINES AT VERTICAL INTERVALS (V.I.) OF 10 FEET.*

Angle of slope to horizontal.	Distance along slope for V.I. of 10 ft.	Horizontal equivalent.
Degrees.	Feet.	Yards.
1	573	191
2	286·5	95
3	191	63
4	143·3	47
5	114·7	38
6	95·7	31
7	82	27
8	71·9	23
9	63·9	21
10	57·6	19
11	52·4	17
12	48·1	16
13	44·5	14
14	41·3	13
15	38·6	12
16	36·3	12
17	34·2	11
18	32·4	10
19	30·7	10
20	29·2	9

7 TO MAKE A SECTION OR PROFILE ALONG A GIVEN STRAIGHT LINE IN A CONTOURED MAP.—The method of doing this will be understood by means of Figs. 14 and 15. Fig. 14 represents some of the contour lines (vertical intervals, 20 feet) drawn by the writer for Blackford Hill, Edinburgh. If a vertical section of this hill were made along the line *AB* (Fig. 14), then the outline of the surface of the ground exposed would be like that shown in Fig. 15. The horizontal scale in the two diagrams is the same, and the vertical scale of Fig. 15 is indicated at the right-hand side. We divide *AB* in Fig. 15 into lengths exactly equal to those in

* See footnote on page 12. Those who know the elements of trigonometry will see that the figures in the second column in the table are just 10 feet multiplied by the cosecant of the corresponding angles in the first column, and that those in the third column are 10 feet multiplied by the cotangent of the same angles. The numbers in the second column are given in feet, as these are the most convenient unit for tape-line measurements; but those in the third column are in yards to the nearest integer, as these are most convenient for measurements with the scale on the sighting-ruler

Fig. 14, and then through the points thus obtained erect perpendiculars

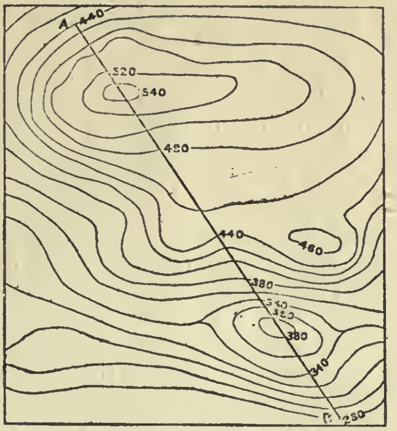


Fig. 14.

(the dotted lines) to represent the corresponding altitudes, and by joining the upper ends of these perpendiculars we obtain the outline shown in Fig. 15. Exercises of this kind are valuable, not only because they

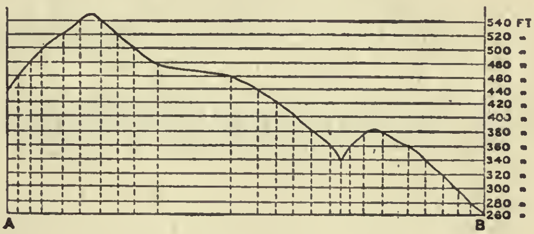


Fig. 15.

help pupils to understand better the meaning of contour lines, but also because they enable them to picture the inequalities of the Earth's surface along any given line in a contoured map.

8. To make from a Contoured Map a Relief Model either in Cardboard or in Clay of a Portion of the School District.—Building up in this way the features of a district is greatly in vogue in Switzerland and Germany, and should be more common in our schools than it is. Relief models are chiefly useful because they enable the pupils to understand and interpret the contoured map. They are apt, however, to give rise to erroneous impressions if the altitude is indefinitely magnified, as is so commonly done. In fact, such models should have the horizontal and vertical scales as nearly as possible the same. If cardboard is used, it can be selected of such a thickness as to give the proper vertical scale. The contour lines can be copied on to the cardboard from a contoured map of the district,* and the cardboard cut along these lines and glued in superimposed layers.

* The 6-inch Ordnance Survey Map gives the contour lines for vertical intervals of 50 feet. This horizontal scale is too small and the vertical intervals are too great; but the map can be enlarged by photography to any required scale, and then the intermediate contour lines, say for every vertical interval of 10 feet, inserted with sufficient accuracy, by actual survey of the district.

For a good account of the method of making relief-models in clay, plaster, papier-maché, &c., see the chapter on "Relief Maps and their Construction" in the appendix of *How to study Geography*, by F. W. Parker (Appleton & Co., New York).

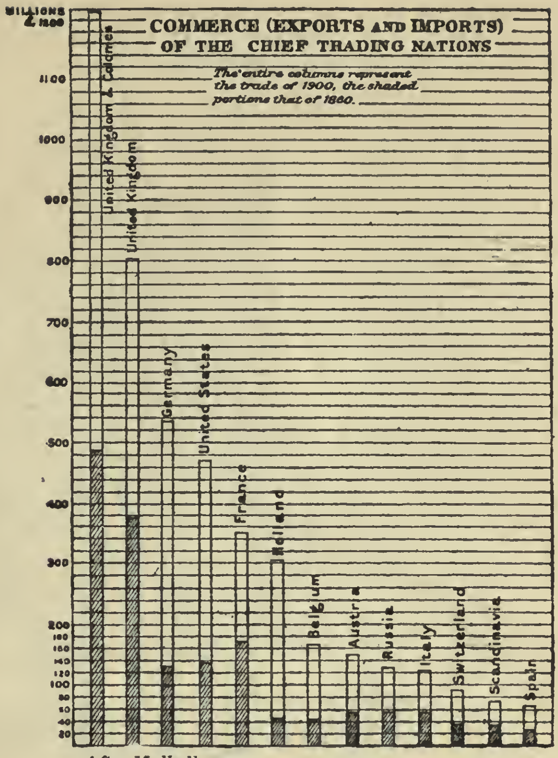
9. TO PRACTISE USING A MAP IN THE FIELD.—Very few school-children at present could from a map point out the exact direction in which a given town or mountain, &c., lies. Therefore, at one of the excursions it should be fully explained to the scholars that when actually using a map in the field it should be laid flat, with its cardinal points correctly placed as determined by a compass-needle, after allowing for the difference determined in Exercise I., page 7, and that then they can tell the direction of any required object *A* by placing a stick on the map so as to pass through the representations of their standpoint and the place *A* on the map. After this the map should be prominent in all excursions, until by comparing it with the actual landscape the pupils can read and interpret the symbols of the map almost as well as they can read and interpret the symbols of a printed page.

10. TO COLOUR A PLAIN MAP OF THE DISTRICT SO AS TO SHOW THE CONDITION OF THE SURFACE, ESPECIALLY AS TO VEGETATION.—The maps made by the pupils should not be confined to topographical features and political divisions, as is generally the case. They should be given an outline map of the locality, and asked to colour it to show the distribution of cultivated and pasture land, and woods.* Maps showing the distribution of rainfall, or of temperature, &c., might be copied and discussed by the pupils. For example, the writer has found an interesting and useful exercise to be to require students to copy a coloured map showing the mean annual distribution of rainfall in Scotland or England, and to state all the conclusions they draw from their maps.

11. TO DRAW GRAPHS OF COMMERCE.—Although commercial geography belongs rather to the curriculum of commercial and technical colleges, yet, instead of asking our pupils to commit to memory tables of products, exports and imports, &c., it would certainly be much more interesting and instructive to teach the older pupils to represent these graphically. The teacher can find abundant data for such exercises in the Blue Book issued by the Board of Trade and called *The Annual Statement of the Trade of the United Kingdom*, or in *The Statesman's Year-Book*, *Whitaker's Almanack*, and *Oliver & Boyd's Almanack*, or in *The Industries and Wealth of Nations*, by M. G. Mulhall, or *National Progress in the Queen's Reign*, by the same author. Figs. 16 and 17 are based on information obtained from the Blue Books mentioned above, and they show at a glance the relative value of the commerce of the countries represented. How many useful questions could be discussed from these two diagrams!

* An exceedingly useful Botanical Map of Midlothian was prepared by the late Mr. Robert Smith, B.Sc., and is sold by Mr. Bartholomew. It shows in a most instructive manner the influence of elevation on vegetation. Similar maps of the other districts of Scotland are being prepared under the supervision of Prof. Patrick Geddes.

The up-to-date teacher will get material for several interesting geography lessons from the Vegetation Map of Scotland in Sir Archibald Geikie's *Scenery of Scotland*.



After Mulhall.

FIG. 16.

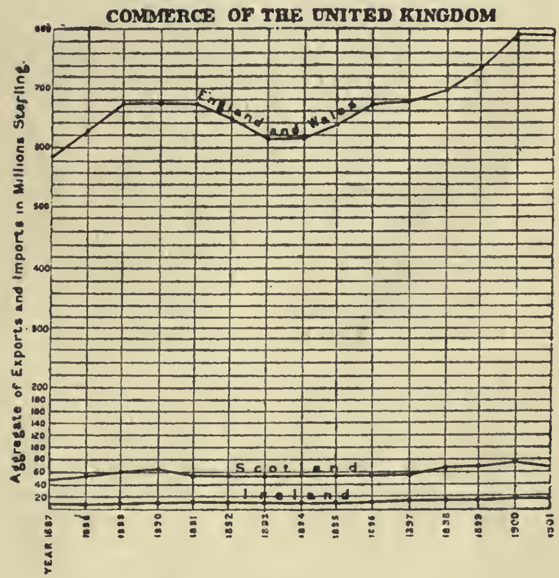


FIG. 17.

An interesting piece of original investigation for the oldest pupils in a school would be to get them to collect, from their own inquiries, information as to the annual value of the chief industries or the commerce of the town, and to represent the results by diagrams. One advantage of all such graphical representation is that it enables us to forecast at a glance the future tendencies of commercial development.

12. TO DETERMINE THE OBLIQUITY OF THE ECLIPTIC AND THE LATITUDE OF THE SCHOOL.—While explaining the seasons, we tell our pupils that at midsummer the Sun is 23½° north of the Equator, and at midwinter the same distance south of it—and they, of course, accept our statement; but, as the statement is not based on their own observation, they fail to comprehend its full meaning and consequences. If they could measure for themselves the amount of the Sun's apparent movement in latitude, their interest in it would be greatly increased. This can be done as follows:—At a level part of the playground freely exposed to the Sun erect a vertical post *AB* (Fig. 18). Measure the length

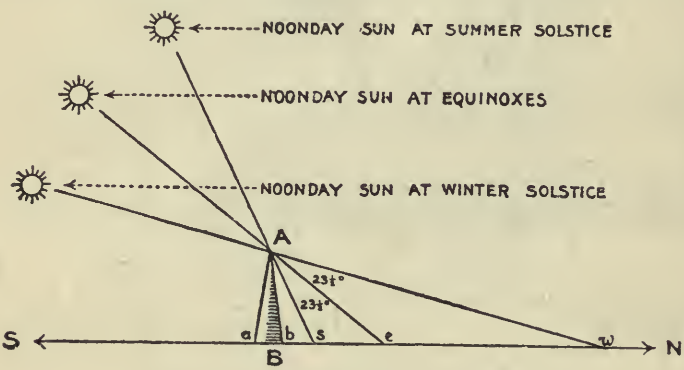


FIG. 18.

Be of its midday shadow at an equinox, and again on Midsummer or Midwinter Day (*Bs* and *Bw* respectively). The pupils can then actually measure on the paper the angle *eAs* or *eAw*, and discover it to be about 23½°.

Again, the latitude of the place can be measured; for the teacher can explain that it is equal to the angle *eAB* (or the noonday distance of the Sun from the zenith at either equinox).

13. Since the quality of the geographical instruction in schools depends mainly on the thoroughness of the training in the subject received by teachers, a useful practical exercise for students in Training Colleges would be to require some of them to conduct geographical excursions of school-children.

Such are some of the ways in which we can make our teaching of geography more real, more practical, and more interesting. To us, with our world-wide Empire and commerce, geography ought not to be the wearisome and unprofitable task that it now is. In the whole circle of school subjects none is better fitted, under skilful teaching, to train the pupils in the method of investigation, to cultivate their imagination, to develop their observing faculties, and thus help them towards a fuller enjoyment of the infinite variety, order, and beauty of the world.

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