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Address to the Geographical Section of the British Association. Belfast, August 19th, 1874

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Source: *Proceedings of the Royal Geographical Society of London*, Vol. 19, No. 1 (1874 - 1875), pp. 63-71

Published by: [Wiley](#) on behalf of [The Royal Geographical Society \(with the Institute of British Geographers\)](#)

Stable URL: <http://www.jstor.org/stable/1799779>

Accessed: 12/06/2014 17:03

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2. *Address to the Geographical Section of the British Association. Belfast, August 19th, 1874.* By MAJOR WILSON, R.E., F.R.S., F.R.G.S. Director of the Topographical Department, Horse Guards, War Office, President of the Section.

[ABRIDGMENT.]

It has, I believe, been usual in the addresses to this Section to select some special subject for remark; and I will therefore, if you will allow me, before alluding to the geographical achievements of the year, draw your attention to the influence which the physical features of the earth's crust have on the course of military operations, to the consequent importance of the study of Physical Geography to all those who have to plan or take part in a campaign, and to the contributions to geographical science that are due, directly or indirectly, to war and the necessity of preparing for war. I do this the more readily from a feeling that sufficient importance is not attached to the study of geography as a branch of military science, and that of recent years officers in our foreign possessions and colonies have not received that encouragement which they might have expected to engage in geographical research, as well as from a hope that new life may be given to that spirit of enterprise and love of adventure in strange lands and amongst strange people which have so long distinguished the officers of both services.

To show how varied are the conditions under which war has to be carried on, and how much its successful issue may depend on a previous careful study of the physical character of the country in which it is waged, it is only necessary to remind you of the recent operations on the Gold Coast, brought to a successful issue in an unhealthy climate and in the heart of a dense tropical forest, where an impenetrable undergrowth, pestilential swamps, and deep rivers obstructed the march of the troops; of the Abyssinian Expedition landing on the heated shores of the Red Sea, and thence, after climbing to the lofty highlands of Abyssinia, working its way over stupendous ravines to the all but inaccessible rock crowned by the fortress of Magdala; of the march of the Russian columns across the steppes and deserts of Central Asia to the Khivan oasis—one month wearily plodding through deep snow, the next sinking down in the burning sand, and saved from the most terrible of disasters by the timely discovery of a well; and, lastly, of the great struggle nearer home, the last echoes of which have hardly yet passed away, when the wave of German conquest, rolling over the Vosges and the Moselle, swept over the fairest provinces of France.

The influence of the earth's crust on war may be regarded as twofold: first, that which it exerts on the general conduct of a campaign; and second, that which it exerts on the disposition and movement of troops on the field of battle. Military Geography treats of the one, Military Topography of the other; and it is well to keep this broad distinction in view, for, as with Strategy and Tactics, they stand in such close relation to each other that it is not always easy to say where Geography ends and Topography begins. Of special importance in the first case are great inequalities or obstacles that confine or obstruct the movement of large bodies of troops, and those features which retard or accelerate their march, whether they be mountain-ranges, ravines, or defiles with inaccessible sides, deep crevasses (such as those washed out in some steppe-countries by winter rains), extensive plains, dense forests, rich cultivation (such as that of the valley of the Po, which confines all movements to the roads), enclosed country like that of England and Ireland, great marshes (such as that of the Beresina and Pripet), or running or standing water that cannot be crossed without a bridge or boats. Of no less importance are those features which do not allow of the employment of large masses of troops or of special arms, such as Cavalry and Artillery, as well as

those circumstances that render the subsistence of large armies difficult or impossible. In the second case, all inequalities of the ground, however slight, the nature of the soil and the effect which rain has upon it, the extent and character of the vegetation and cultivation, and all buildings, whether isolated or collected into towns and villages, are of more or less importance.

The climate of the theatre of war must always have an important influence on military operations, and should be the subject of careful study. Our own experience in the Crimea shows how much suffering may be caused by want of forethought in this respect. General Verevkin's remarkable march of more than a thousand miles, from Orenburg to Khiva, with the thermometer ranging from -24° to 100° , without the loss of a man, shows what may be accomplished with due preparation. Nor should the geological structure of a country be overlooked in its influence on the varied forms which the earth's crust assumes, on the presence or otherwise of water, on the supply of metal for repairing roads, and (if we may trust somewhat similar appearances on the Gold Coast, at Hong Kong, and in the Seychelles) on the healthiness or unhealthiness of the climate.

In any campaign undertaken by England, the sea must always play an important part as the great base of operations and main line of communication with the mother country. Special consideration must be given to the facilities which the coast-line of the theatre of war offers for effecting a landing; to the anchorages, shoals, roads, inlets, harbours, and depth of water along the coast; to the influence of the winds, tides, and currents on the entrance to harbours; to the nature of the mouths of rivers; and to the time, force, and duration of periodical storms, and their effect on navigation.

A general knowledge of the geography and topography of a country is, however, in itself insufficient for military purposes; it is necessary, in addition, to know the present state of roads and bridges, the depth and width of streams, the state of the soil and of its cultivation, &c., and especially the best means of turning the ground to account for the object in view. This information is obtained by what are called Military Reconnaissances.

It is scarcely necessary to remind you that though mountain-ranges and rivers materially affect the operations of war, they are by no means insurmountable obstacles. The Alps have been repeatedly crossed since the days of Hannibal; Wellington crossed the Pyrenees in spite of the opposition of Soult, Diebitsch the Balkan though defended by the Turks; and Pollock forced his way through the dreaded Kyber; whilst there is hardly a river in the length and breadth of Europe that has not been crossed even when the passage has been ably disputed. Soult escaping from Wellington over the Sierra de Catalina by a smuggler's path, Ochterlony penetrating into the heart of the Goorkha country by a wild mountain track, the rear divisions of Napoleon's army at Leipsic sacrificed from a neglect to reconnoitre the Elster, show how close the examination of a country should be. This is, however, hardly the place, nor would there be time, to discuss the minuter details of military geography and topography; they will be found in the works especially devoted to the subject.

Queen Elizabeth's minister was right when he said that "knowledge is power;" and a knowledge of the physical features of a country, combined with a just appreciation of their influence on military operations, is a very great power in war. A commander entering upon a campaign without such knowledge may be likened to a man groping in the dark; with it he may act with a boldness and decision that will often ensure success. It was this class of knowledge, possessed in the highest degree by all great commanders, that enabled Jomini to foretell the collision of the French and Prussian armies at Jena in 1807, and in later years enabled a Prussian officer

when told that MacMahon had marched northwards from Chalons, to point unerringly to Sedan as the place where the decisive battle would be fought. Chief Justice Daly, in his address to the American Geographical Society, draws attention to the Franco-German War, as "a war fought as much by maps as by weapons," and attributes the result to "skilful military movements, performed by an army thoroughly acquainted with all the geographical features of the country over which it was moved;" and, he adds, "It teaches us that if the fate of a nation may depend upon a battle, a battle may depend on a knowledge of geography."

As, then, all military operations must be based on a knowledge of the country in which they are to be carried on, it should never be forgotten that every country contiguous to our own (and the ocean brings us into contact with almost every country in the world) may be possibly a theatre of war, and that it is equally the duty and policy of a good government to obtain all possible information respecting it. More especially is this the case with regard to the little known districts, inhabited by uncivilised or but partially civilised races, that lie beyond the frontiers of many of our foreign possessions and colonies. Is it with much satisfaction that we can turn to the efforts made by this country to acquire that geographical knowledge which may be of so much importance in time of need? Though we had for years had military establishments on the Gold Coast, and though we had, more than once, been engaged in hostilities with the Ashantees, and might reasonably have expected to be so again, no attempt appears to have been made to obtain information about the country north of the Prah, or even of the so-called protected territories. The result was that, when the recent expedition was organised, the Government had to depend chiefly on the works of Bowdich, Dupuis, and Hutton (written some fifty years ago), and on a rough itinerary of the route afterwards followed by the troops, for their information relating to the country and its inhabitants. Nor is the Gold Coast any exceptional case: with settlements at Singapore and Penang, we know absolutely nothing of the interior of the Malay peninsula, and not much of the adjacent islands. How little have the garrisons of Aden and Hong Kong contributed to our knowledge of Arabia and China! What advantage has been taken of the presence of the officers who have been in Persia during the last ten years, to increase our knowledge of that country—knowledge which would be very useful at present in the unsettled state of the boundary questions on the northern and north-eastern frontiers? How little has been added to our knowledge of Afghanistan since the war in 1842! and what part did India take in Trans-Himalayan exploration before Messrs. Shaw and Hayward led the way to Yarkand and Kashgar?

It was with feelings of no slight satisfaction that many of us heard last year that the policy of isolation and seclusion which India appeared to have adopted, as the last soldier of Pollock's relieving force recrossed the Indus, was at last to be broken, and that an expedition, well found in every respect, was to be sent to Kashgar. It seemed an awakening from the long slumber of the last thirty years, during which we were content to stay at home in inglorious ease, resting under the shadow of the great mountain-ranges of Northern India, whilst we sent out Mirzas and Pundits to gather the rich store of laurels that hung almost within our grasp. Far be it from me to depreciate the valuable services of those gentlemen—services frequently performed at great personal risk and discomfort; but who can compare the results they obtained with those that would have been brought back by English officers, or by travellers such as Mr. Shaw, Mr. Ney Elias, and others?

If it be true (and few will be disposed to doubt it) that Arctic exploration is one of the best schools for officers of the navy, it is equally true that exploration on shore is one of the best schools for officers of the army. The officer who

has had for weeks or months to depend on his own resources, organising his own commissariat and transport, fighting his way amidst hardship and discomfort, against all difficulties, will be found to possess many of the most valuable qualifications for active service in the field; and not the least of these will be that eye for ground, or ready appreciation of relative height and distance, which often comes like a second sense to the explorer.

It has been said that if officers travelled in countries where Government could no longer protect them, they might be killed by the natives, and that then, if the murderers were not punished, England would suffer loss of prestige; but is this the case? Did any loss of prestige follow the murder of Conolly and Stoddart in Bokhara or of Hayward in the mountains of Gilgit? It is hard, too, to believe that the danger of loss of life has not been somewhat exaggerated, when we find missionaries living for several years in comparative security at Coomassie; Maltzan, Halevy, and others, exploring Southern Arabia; Ney Elias crossing China at a time when political circumstances made travelling more than usually unsafe; Prjewalsky, with six Kuzaks, wandering about China for nearly three years, and spending several months on the northern borders of Thibet; Shaw and Hayward finding their way independently to Kashgar; and, finally, the Kashgar mission hospitably received not only by the Amir of Kashgar, but by the Kirghiz of the Pamir and the Mir of Wakhan. As a matter of fact, the number of travellers who lose their lives at the hands of the natives of the countries in which they are travelling is quite insignificant when compared with the number of those who return in safety. Let us, then, hope that the Kashgar mission may date the commencement of a new era during which geographical enterprise may be encouraged, or, at any rate, not discouraged, amongst the officers of the army; and that if few will now deny that a knowledge of Ashantee, of Yemen, of the northern and north-eastern frontiers of Persia, of Merv, Andkhui, Maimana, Badakhshan, and Wakhan would have been of importance in the year just passed, it may not be forgotten that a knowledge of these countries may be of still more importance in a not far-distant future.

May we not take a hint in this respect from our now near neighbours in Central Asia, the Russians? No one who has followed their movements can fail to have been struck by the intense activity of their topographical staff, an activity that can only be compared to that of England at the period when Burnes, Eldred Pottinger, Wood, Abbott, Conolly, and others, whose names are ever fresh in our memories, were penetrating into the wildest recesses of Central Asia. No sooner is Khulja occupied, than parties start out to examine the mountain-passes beyond; the capture of Samarcand is followed by an exploration of the Zaravshan Valley; Khiva has scarcely fallen before detachments are out in all directions surveying the Amu and tracing the canals that give life to the oasis; rarely does a caravan start for Manas, Urumtchi, or any place of which little is known, without an accompanying topographer. Persia has been traversed in various directions by members of the staff, and, as there has already been occasion to notice, Captain Prjewalski has found his way to the northern plateau of Thibet.

The Records of the Royal Geographical Society and of the Geographical Section of this Association show how much has been accomplished by individual officers of the English army, too often without assistance; and that if encouragement were given to them there would be numbers of men able and willing to compete with the Russians in the great field of geographical exploration.

I pass now to a consideration of the contributions of war to geographical science; and amongst these it is perhaps hardly necessary that I should mention the very obvious manner in which military operations teach us geography by directing our attention for the time being to the country in which they are

being carried on, or the direct geographical results that have followed many campaigns from the days of Alexander to our own. I have no doubt that last winter many persons whose previous knowledge of Ashantee was confined to a vague feeling that it was somewhere on the west coast of Africa, were following the course of the operations with intense interest on the maps issued by our geographical establishments: and if anyone will take the trouble to compare the maps of Asia published fifteen years ago with those of the present day, he will see at once how much the cause of geography has gained by the Russian campaigns against the Khanates. The Russians are indeed far in advance of us in all that relates to those survey operations and that geographical exploration which should always be carried on simultaneously with the advance of an expeditionary force into an unknown or but partially known country; they have long since realised the importance, almost necessity, of accurate geographical knowledge based on sound systematic survey, and having learned, in time, the lesson that opportunities once lost may never be recovered, make every effort to take advantage of those that are offered to them. In the expedition against Khiva, each column had attached to it an astronomer and small topographical staff, whose duty it was to fix the geographical positions of all camps, and map the route and adjacent country, whilst officers on detached duty were instructed to keep itineraries of their routes which might be fitted into the more accurate survey. On the fall of Khiva an examination of the Khanate was at once commenced; and it was even thought necessary to send Col. Skobelof, disguised as a Turcoman, to survey the route by which Col. Markosof should have reached the Oasis. It is much to be regretted, in the interests of geography, that some such system was not adopted during the recent operations on the Gold Coast, and that so little, comparatively speaking, has been added to our knowledge of Ashantee and the Protectorate. The conclusion of peace with King Coffee, and the effect that must have been produced on the inland tribes by the destruction of Coomassie, appear to offer facilities for the examination of a new and interesting region, which it is to be hoped will not be neglected by those who are able and willing to take part in the arduous task of African exploration; and I trust that before many years have passed we shall know much more than we do at present about the Prah, the Volta, the great trade-routes leading from the coast to Central Africa, and of the open grassy country abounding in game which is said to lie between Coomassie and the lofty mountain-range called on our maps the Mountains of Kong.

The most important military contributions to geography have undoubtedly been those great topographical surveys which are either completed or in progress in every country in Europe, except Spain, Turkey, and Greece. Frederick the Great was, I believe, the first to recognise that in planning or conducting operations on a large scale, as well as in directing many movements on the field of battle, a commander should have before him a detailed delineation of the ground of a whole or part of the theatre of war. To supply this want Frederick originated Military Topography, which, in its narrower sense, may be defined as the art of representing ground on a large scale in aid of military operations. It was found, however, that during war there was rarely sufficient time to construct maps giving the requisite information, and thus the necessity arose of collecting in peace such data as would enable maps to be prepared that should show the extent, relative position, and comparative height and steepness of mountain-ranges, as well as their connection with each other, the course of the rivers, the direction of the main lines of communication, the position and importance of towns, the extent of morasses, forests, and other obstacles to the free movement of troops, and which at the same time should distinguish by different depths of shade those places over which troops could or could not be manœuvred.

In this necessity may be seen the origin of all national topographical surveys, including our own, which was commenced as a purely military survey in 1784 by General Roy, and transferred in 1791 to the old Board of Ordnance. The gradual development of these surveys, and the various stages through which they have passed before reaching their present state of excellence, need not be noticed here; but it may be remarked that, whilst in all foreign countries the topographical maps have retained their essentially military character, the Ordnance Survey maps have for many years past been constructed with the paramount view of their general utility to all classes in the kingdom, and the military character of our topographical map on the one-inch scale has had to give way to the civil requirements of the State. We find also on the Continent that the Cadastral surveys are conducted by a civil department of the State, the topographical surveys by the War department; whilst in our own country all operations connected with the Cadastral and topographical surveys are concentrated in one department, the Ordnance Survey, which since 1870 has formed part of a purely civil department of the State, the Office of Works.

Side by side with the large establishments engaged in the production of the topographical maps, there have grown up in most countries extensive departments, sometimes employing from fifty to sixty officers, whose duty it is to supplement the maps of their own and foreign countries by the collection of all information, of whatever nature, that may be useful in time of war, to arrange and classify the information thus collected, to prepare what may be called military-geographical-statistical descriptions of all possible theatres of war whether at home or abroad, to study the science of marches, the influence of ground on the movement of troops, the best and most rapid means of concentrating and moving large bodies of troops, and to plan campaigns under varied circumstances. The brief interval that elapses between the declaration of war and the commencement of hostilities, the rapid movements of armies, and the short duration of campaigns at the present day, have shown more clearly than ever the imperative necessity of previous preparation for war; and the publication of the great surveys of most European countries has given an impetus heretofore unknown to the studies I have alluded to. In our own country the Crimean war gave birth to a small topographical and statistical department; but only four years ago its staff consisted of but three officers, and even now it is hardly as large as one of the sections of its Continental brethren.

The progress of the European surveys, and especially of our own, has been marked by many results which have indirectly influenced the advancement of geographical science. Amongst these may be mentioned the improvements in instruments made during the progress of the Triangulation, the invention of the Drummond Light, of Colby's compensation bars, &c., the connection of the English and Continental systems of triangulation, the pendulum observations at various places, the measurement of arcs of the meridian, the comparison of the standards of lengths of foreign countries, of India, Australia, and the Cape of Good Hope, with our standard yard, which has recently been completed at the Ordnance Survey Office, Southampton, &c. In the same category may be placed the improvements in the art of map-engraving, in the application of chromolithography to the production of maps, as exemplified in the Dutch process of Col. Bessier, and in the Belgian maps, and the employment of electrotyping to obtain duplicates of the original plates. By the latter process copies are taken of the engraved plates in different stages of their progress, and with different classes of information engraved on the different copies, which if mixed together would have confused them. Thus the one-inch map of England is published in outline with contours, with the hills complete but without contours, with the geology, &c. The art of photography

has been largely employed in the production of maps, and its use is on the increase both in this country and on the Continent, and especially in the Government Departments in India. The method of copying maps by photography without any error in scale or any distortion that can be detected by the most rigid examination, was first proved to be practicable and was adopted in the Ordnance Survey Department in 1854 by Major-General Sir Henry James, for the purpose of facilitating the publication of the Government maps of the United Kingdom on the various scales. Since that date the necessity of rapidly producing, multiplying, enlarging, and reducing maps has tended towards the development of the various photographic processes which have been brought to a high state of perfection, such as photozincography, photolithography, heliogravure, Col. Avet's process used in Italy, papyrotype, &c. Some idea of the extent to which these processes are carried may be gathered from the fact that during the last five years photographic negatives on glass, covering an area of 10,071 square feet, were produced at the Ordnance Survey Office for map-making purposes alone, and from these negatives 21,760 square feet of silver prints were prepared and used in the various stages of the survey. An area of 959 square feet of the negatives was also used in producing 13,595 maps on various scales by the photozincographic process, which was also introduced by Major-General Sir Henry James. It was by similar processes that the Germans were enabled to provide the enormous number of copies of the various sheets of the map of France required during the war of 1870-71.

The topographical maps of European countries vary considerably in scale, the manner in which the ground is represented upon them, and the style of their execution. Proposals have at times been made for the adoption of a common scale, but they have not hitherto met with much success; still, however, Sweden, Norway, Denmark, Prussia, Saxony, Switzerland, Italy, and Western Russia have each a map on a scale of $\frac{1}{100000}$; and it is much to be regretted that Austria, when commencing a new map of the entire monarchy, did not adopt this scale instead of that of $\frac{1}{75000}$. On the flat surface of a sheet of paper all inequalities of the ground must be represented conventionally, either by hachures, by contours, or by a combination of both: each system has its advocates, and the maps of foreign countries present examples of all; but it may be remarked that the use of contours is becoming much more general than it was a few years ago. Any comparison of the maps of the various countries would necessarily occupy much time, so I will only add that, as specimens of engraving, the sheets of our one-inch map are unrivalled, and that no foreign maps can compare for accuracy of detail and beauty of execution with the sheets of our six-inch survey. Our great national survey is the most mathematically accurate in Europe; and it speaks much for the ability of the officers who have brought it to its present state of perfection, that from the very first they recognised the necessity of extreme scientific accuracy in their work, and that they have never had to withdraw from the position they have taken up with regard to the many questions of detail that have arisen from time to time.

Before concluding this portion of my address, I would draw your attention to the appliances used in the minor schools in this country for teaching geography, as they would seem to need some improvement. The subject is perhaps hardly one that comes within the province of the Royal Geographical Society, which has done so much to encourage the study of geography in our public schools; but it might well be taken up by one of the numerous Committees of the School Boards of our large towns. The appliances to which I allude are models of relief-maps, wall-maps, atlases, and globes.

The use of models as a means of conveying geographical instruction has been too much neglected in our schools; if anyone considers the difficulty a

pupil has in understanding the drawing of a steam-engine, and the ease with which he grasps the meaning of the working-model, and how from studying the model and comparing it with the drawing, he gradually learns to comprehend the latter, he will see that a model of ground may be used in a similar manner to teach the reading of a map of the same area. A teacher would probably find the same difficulty in enabling a pupil who had lived all his life in a level country, such as the great plains of Russia, to form from a map a mental picture of a great mountain-range, as in teaching one who had never seen a steam-engine to realise what it was, and its mode of action, from a simple drawing; the model in each case would form a connecting link.

Relief-maps of large areas on a small scale have their uses, but they are unsuitable for educational purposes, on account of the manner in which heights must be exaggerated to make them appear at all; this objection, however, does not apply to models of limited areas on a sufficient scale, which always give a truthful and effective representation of the ground. The difficulties attending the construction of accurate models, and their consequent cost, have proved serious obstacles to their common use in our schools; but models are readily built up from contoured maps, and the means of forming in this manner an instructive series of models of our own country, with ease, rapidity, and at slight expense, are quickly accumulating as the six-inch contoured sheets of the Ordnance Survey are published. Instruction in geography should begin at home; and I would suggest that as the six-inch survey progresses every good school throughout the country should be provided with a model and map of the district in which it is situated. If this were done, the pupils would soon learn to read the model; and having once succeeded in doing this, it would not be long before they were able to understand the conventional manner in which topographical features are represented on a plain surface, and acquire the power of reading, not only the map of their own neighbourhood, but any map which was placed before them. With these models topographical studies, which might be the same for all schools, should be supplied, such as a representation of a coast region, a mountain-lake with surrounding hills, a volcano, or an Alpine district with glaciers; and it would add much to their value if they were accompanied by bird's-eye views and landscape sketches. In Switzerland nearly every school has a model of the country; in Austria, France, and Germany models are largely employed for instructional purposes; they have long been in use in our military schools and colleges; and models of the environs of Plymouth, with corresponding portions of the six-inch map, are used somewhat in the manner I have suggested. The demand for models on the Continent has naturally resulted in their extensive manufacture; and some good specimens have been produced by Delagrave of Paris, Wagner of Berlin, and others; but they do not give all that is required, and are capable of much improvement.

In our wall-maps I think we have been too much inclined to pay attention to the boundaries of countries, and to neglect the general features of the ground. It is difficult to say whether the maps have followed the teachers or the teachers the maps; but I fear instruction in physical geography too often comes after that in political geography, instead of a knowledge of the latter being based on a knowledge of the physical features of the earth. My meaning may perhaps be explained by reference to a wall-map, probably well known to every one, that of Palestine, which frequently disfigures rather than ornaments the walls of our school-rooms. In this map there are usually deep shades of red, yellow, and green to distinguish the districts of Judæa, Samaria, and Galilee, and perhaps another colour for the Trans-Jordanic region, with a number of Bible names inserted on the surface, whilst the natural features are quite subordinate and sometimes not even indicated. There is, perhaps, no book that bears the impress of the country in which it

was written so strongly as the Bible ; but it is quite impossible for a teacher to enable his pupils to realise what that country is with the maps at present at his disposal. How little distinction is made on the maps between the great corn-growing plains of Philistia, the vine- and olive-clad hills that stand round about Jerusalem, the deep depression of the Dead Sea, and the pasture-lands of the Moabite plateau ! and how little do they bring out those peculiar features which in a country the size of Yorkshire enabled the Psalmist to be familiar at the same time with the snows and alpine flora of the Lebanon and Mount Hermon, and with the intense heat and tropical vegetation of the Jordan Valley.

The first object of a wall-map should be to show the geographical features of countries, not their boundaries ; and for this purpose details should be omitted, and the grander features have special attention paid to them. Many attempts have been made in this direction on the Continent, by representing the ground by contours, or by zones of altitude distinguished by tints, more or less deep, of the same or different colours, by giving prominence to rivers, coasts, &c., by reducing the importance of names by writing them small, and by inserting dotted lines instead of bright colours to mark boundaries. None of these attempts have been quite successful ; but they indicate progress in the right direction, and are deserving of attention in this country.

In school atlases the same fault may be traced, physical features being too often made subordinate to political divisions ; and there is also in many cases a tendency to overcrowd the maps with a multitude of names which only serve to confuse the pupil, and divert his attention from the main points.

The use of globes in our schools should be encouraged as much as possible, as there are many physical phenomena which cannot well be explained without them ; and they offer far better means of conveying a knowledge of the relative positions of the various countries, seas, &c., than any maps. If a pupil once learns from a globe the places traversed by the principal parallels and four or eight equidistant meridians, with the most important places near their points of intersection, he will find more than half his difficulties overcome. The great expense of globes has hitherto prevented their very general use, but some experiments are at present being made with a view to lessening the cost of their construction, which it is hoped may be successful.

I cannot pass from this subject without alluding to that class of map which gives life to the large volumes of statistics which are accumulating upon us with such rapidity. On the Continent these maps are employed to an extent unknown in this country, both for purposes of reference and education, and they convey their information in a simple and effective manner. Amongst them may be noticed maps showing the administrative, historical, and statistical features of Germany, the distribution of religious professions of Russia, the industrial maps of the same country, the agricultural maps of Austro-Hungary, &c. Several interesting maps of this nature were exhibited at Vienna last year, one of which may be noticed as illustrating the statistics of the coal-trade in Germany, showing at a glance the districts supplied by each separate coal-field and by imported coal, as well as the proportion of home and foreign coal consumed in those places where there is competition.