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LECTURES.

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Captain M. S. NOLLOTH, R.N., in the Chair.

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MILITARY DRAWING.\*

By Lt.-Col. H. GARNET MAN (late Royal Military College).

It does not appear that the ancients were acquainted with the use and advantage of maps up to the time of Anaximander, or about two thousand two hundred years since; and Ptolemy, who flourished in the first century of the Christian era, was the first who used meridians and parallels of latitude. The early maps were chiefly compiled from the itineraries of the Roman and other armies; and we are much indebted to the army and navy of different civilised nations in every period for the materials from which maps have been constructed.

The art of exhibiting the irregular surface of the earth upon these maps when their scale will admit of it, is of very modern date, and upon it hinges, in a great degree, the tactics of modern war.

A General now possesses an immense advantage over the heroes of antiquity from the facilities of gaining a picture of the country which is the theatre of war, or any part of it that may be necessary, upon the spur of the moment; these pictures are drawn by persons appointed for the express purpose, and, indeed, it were useless to insist upon the utility of an art now becoming more generally known and of such acknowledged importance.

\* I have, in this Paper, made large extracts from a work published many years ago by Mr. Buor, Professor of Military Drawing at the Royal Military College; a work I consider to be one of the best on this subject.—G. MAN.

But there are many others to whom the art, in all its variety, is of equal importance in their several capacities; to civil engineers, geologists, gentlemen of landed property, and others, for conveying information generally of the natural face of a country. These are the advantages of modern over the ancient maps, which, besides their rudeness and inaccuracy, were only lineal, or consisting of roads, rivers, boundaries, &c.

It is curious and interesting to observe how, from the rudest beginning, the moderns have raised the art of representing ground, a word commonly used to express that part of a map or plan which is shaded so as to give an idea of the hills. The little elevated molehills which anciently, and even a few years since, and still in some few instances, fill up the spaces between the rivers on maps, have, by degrees, been blended together and formed into regular chains of heights, their magnitude and steepness being estimated by the breadth and intensity of their shade; and the geographer has borrowed from time to time ideas from the military draughtsman, until the irregular face of a country is now given in a general manner, more agreeably to its natural aspect than it was formerly. Hitherto, however, this improvement in maps, although of such general advantage, has been chiefly confined to those intended for military purposes. The establishment at the Tower of London was the first of its kind, and many plans upon these principles were there collected; in some, as old as the beginning of the last century, a great variety of styles and traces of an enlarged understanding of the subject might be seen, according to the merit of the individuals by whom they were drawn; many attempts to imitate nature as seen from a point above, or according to the orthographical projection, reflect great credit upon their authors, considering the low state of water-colour drawing in this country at the time they were drawn. On the continent great importance has ever been attached to this kind of drawing; but, until within a few years, the Tower establishment and the Royal Military Academy at Woolwich contained almost exclusively the only persons who in this country were qualified for such an undertaking.

The Ordnance Survey of Great Britain and Ireland, which is perhaps the best ever undertaken, with its adjuncts under Colonel Colby, opened a grand field for the acquirement of topographical knowledge; and the Royal Military College at Sandhurst has become a school in which such knowledge has been much cultivated. From these sources, as might be expected, the British Army is now well provided with persons who possess the necessary talent for supplying it with the most interesting documents of the kind that can be desired; and to make this species of drawing more generally known in every line of life where it can be useful, is a great desideratum.

#### *Military Sketches.*

Despatch and simplicity of execution are the great things to be aimed at in a military sketch, and, although the greatest possible accuracy may not be absolutely necessary, yet this want of it should not become a cloak for glaring errors, for it must be remembered that these sketches are often the most authentic sources of information we possess as to the topography of distant countries; if they are thus defective, there is only one thing in their favour, namely, that when still further reduced into geographical maps the errors are considerably diminished. The errors to which we at present

allude are, first, the general outline being incorrect, because distant points have not been fixed from lines of sufficient length, or by using very imperfect instruments; secondly, that the hills or mountains, not being drawn with a proper regard to their real form or steepness, cannot be properly connected when the separate portions of a large work are to be blended together in one general map.

It may be convenient to separate military sketches into two divisions: first, the rapid sketch of a position in advance, or of a battle immediately after it is fought, to be sent with the despatches; or of a line of route, &c.; these may be done secretly, with but little assistance from instruments, sometimes without any, and, as they are to serve only a transient purpose, much latitude must be allowed to those who perform such service. Secondly, such sketches, or rather surveys, as may be undertaken by officers at periods of greater leisure, yet not admitting of a numerous party, with elaborate instruments, being employed upon them, and also frequently requiring some degree of secrecy.

From the first division of military sketches we cannot expect much when they have served their original purpose; their imperfect execution excludes the further use of them when anything better can be found. It is to the *second* division that the most importance will always be attached; it is a collection of these that will ever be considered valuable in a military and geographical, perhaps we may say also a geological, point of view, and therefore the errors before mentioned should be avoided as much as possible.

The principles of military sketching cannot differ essentially from those of surveying. They both consist in determining the sides and angles of real or imaginary figures upon the surface of the earth. These are always resolvable into triangles, by means of which we lay down these figures upon paper to any required scale. But the practice differs very considerably; and it is for this reason that they are called *sketches* rather than surveys, because so much of them is usually done by the eye, instead of being a continued series of angles and measured lines, as in the more elaborate surveys.

As, in surveying large tracts of country, large triangles must be first formed with great care, to find the true relative situation of distant objects, and these again subdivided into smaller ones, until there is no longer any fear of the errors of mere surveying accumulating too far before they are checked by reference to those points, so in military sketching, when a tract of country is to be drawn, containing one hundred square miles or more, a similar proceeding cannot be safely dispensed with, for nothing can ensure a proper degree of accuracy but a triangulation of some kind.

It cannot, therefore, be too strongly recommended to persons employed on this service to pay great attention to these points. It may not be improper to mention in this place, that it is usual to consider all military plans whatever, as made up of two component parts, one of which is called ground, and comprehends the variety of surface only; the other, called detail, embraces roads, rivers, cities, towns, villages, marshes, woods, fords, bridges, and every other minutiae, the existence of which can be essential in a military point of view.

We have adhered to this distinction in this place, although not in surveying, because it is the practice in some cases to express by certain characters the various objects constituting the details of a plan, and where no time can be spared for drawing them as they really are; while in surveys, every house or cluster of houses, &c., will always be drawn as they happen to stand; every road with hedge or other fence will be shown by two lines, and when passing over a common or otherwise, and not bounded by fences, it will be shown by two dotted lines, the line always showing a defined boundary, and the dotted line one that is not defined; whereas, in military sketches, a few houses, without reference to their precise disposition or a single spot, denotes a village; a single line will be a bye-road; a double line, a post road; a dotted line, a footpath; a circle with small teeth, a water mill; and so on. We shall not discuss the advantage of retaining these characters, as a four-inch scale is abundantly sufficient for every important object to be drawn as it is in nature, except being somewhat larger; but in geographical maps, or any others on a small scale, which preclude the possibility of doing without them, or in very hasty sketches, they are certainly indispensable.

Many instruments have been contrived for military sketching, each of which has some advantage peculiar to itself, but the only ones we shall mention are, the surveying compass, Sir H. Douglas's reflecting semi-circle, the pocket sextant, and the plane-table. To these must be added a case of leather to hold the sketches, and an ivory protractor to lay down the angles which are taken by the compass, and also the distances; these are contained in the sketching case, with a pencil. The sketches are drawn upon paper or ass's skin: the latter has perhaps some advantage over paper from its not imbibing the moisture of the atmosphere, and therefore preserving greater uniformity in the strength of the black-lead pencil; still as no two pencils are exactly alike in texture, when one is exhausted another may not match the work done by the first, and the difference is not greater than what arises from the unequal degree of moisture imbibed by paper in different states of the atmosphere. The skin is also very expensive; hence, when the sketch is transferred to paper, it is rubbed out to make room for another, and the original sketch is then lost altogether. Upon the whole, and considering the advantage of preserving original sketches, paper mounted upon cloth should be preferred when these instruments are used.

One of the most essential things to be acquired is that of judging distances with accuracy. Upon this everything depends in a hasty sketch, where instruments are sparingly used, or excluded altogether. It is commonly acquired thus: the value of the pace is previously ascertained upon a measured distance—a long distance is best, as the mean value of a pace can be established upon it with greater exactness than on a small one; a distance is then judged, and afterwards paced, the difference is noted, and the practice continued, until the student is competent to trust himself in judging distances of considerable length. He is now capable of sketching by this method, transferring the principles and artifices of surveying into it as completely as the exclusion or absolute want of instruments will admit; that is to say, judging, or, if he please, pacing his distances, and operating exactly as he would do were they measured, and his angles also.

Before quitting this subject, it may be right to mention that, in this rapid sketching, Sir H. Douglas's semi-circle is perhaps the best instrument to be used, if an instrument be allowed, because it will determine the places of houses, &c. with great despatch and correctness, thus leaving very little to be done by judging or pacing distances; for a large piece may be rapidly sketched even on horseback, if a single distance is first assumed as a base, and from it several objects fixed, which leaves nothing more to be done than filling in the sketch by the eye; but the circumstances under which military operations are performed are so extremely varied, that an officer must be left to judge for himself upon the necessity for using or rejecting instruments according to them. When a person has been regularly taught to make correct plans by any of the methods I have mentioned, he will find, that barely riding over ground, and examining it with the eye of a military man, will be sufficient for him to describe it roughly upon paper, and that such a sketch as he can produce by this means, especially if aided by a few angles and notes that take little time to obtain, will communicate a very competent knowledge of the ground to any other officer, for whose use it may be required. It is a practice with many persons to obtain, if possible, provincial maps, and lay down the ground upon enlarged outlines from them; but, unless these maps are good, we doubt whether much is gained by this proceeding; for equal error will arise by hastily enlarging a bad map, as in trusting to the eye occasionally corrected by a few angles, nor can such maps always be had; indeed, any plan enlarged, unless it be of triangles or buildings, which have the dimensions actually written in their proper place, will always be a failure.

It will be in vain to expect that pacing and taking bearings by a compass through a winding road of great extent can possibly be true; it may be barely trusted to for short distances and straight roads, but not otherwise, for the angles are often uncertain, and so are the paced distances in many cases; we must therefore devise a method which will obviate these objections, and, while it ensures general accuracy, throws all the errors upon those parts which are of the least importance. We begin by measuring, or at least pacing, a base as long as possible, if paced, it should be gone over two or three times, and the mean of them taken for the true length. There are often great difficulties in selecting a spot favourable for this purpose; it most commonly happens that when a spot has been found, it lies so inconveniently as to make the intersection of distant objects from each end too acute to be trusted to.

Now, from points thus fixed with much care, other objects may be determined, always, if possible, in the larger triangles, having three lines passing through the same points, and the work will be more correct than when we determine too many from the original base, a practice much to be avoided, for the errors occasioned by so many acute intersections at the commencement, if they are not checked properly from one another, or others better situated for that purpose, will infallibly derange the whole work. It must be laid down as a principle that the most conspicuous objects are to be most correctly placed, and the minor points derived from them; by this means we command the greatest possible accuracy, and throw all the errors upon those parts where they can be propagated no further.

It is a good method to take as many angles as possible at each station, and make our selection of the greater triangles afterwards, unless, from a previous knowledge of the country, that has been already arranged; and it will generally happen that we can see the interior of a triangle from at least two of the sides which inclose it; if not, the points therein must be fixed from any other side of any adjoining triangle where they can be seen, as each side of a great triangle becomes a base for fixing interior points. The triangles are generally laid down by a protractor in military sketches, but, as we suppose in this division that time and instruments are allowed, and as we can produce a sketch little short of a real survey in point of accuracy, we have no hesitation in recommending that those triangles which may have sides of one or two feet in length upon paper, or from three to six miles in length upon the four-inch scale, should be calculated and laid down by the length of the sides themselves. This is my own practice, because I know that when these lines exceed eighteen inches, let the scale be what it may, they will become very liable to error if continued too far by a protractor, and hence, if only a few of the greater triangles are calculated, and so laid down, we are assured of their accuracy, and also of the interior points when laid down by a protractor. The method about to be described depends so much upon the correctness of the triangles, that they must be managed with the most scrupulous attention.

The instruments chosen for finishing the sketch after the triangulation is finished, will be either the plane-table, or the sketching case and skins, aided by the surveying compass; for the triangles themselves may be formed by the sextant or theodolite at the option of the person employed.

Of the first-mentioned instrument, which is far the best for expedition and accuracy, we need say but little here. What remains is common to it and the sketching case, only with the difference arising from the method of mere sketching, as it respects the plane-table, and laying down the work when we use the sketching case and skins. Having determined as many points as may be deemed necessary, some of which should fall without the limits of the sketch, and will be productive of great advantage while sketching near its boundaries, as well as when joining it to others,—we must dot them down from the paper they have been constructed upon to the skin we propose to use, and mark their names. Now we go to one of those points and take the bearing of some other, the more distant the better, and, connecting the two points in question, we, by means of this bearing, lay down a line representing the magnetic meridian of that particular compass employed, for they generally differ a little in different instruments as before noted, and also many others at about an inch apart; we are now in condition to begin our sketch in the manner following:

Before we quit the place, if any ground, road, or other object necessary to be noticed, is either there or near it, we draw it on the spot, and then, always keeping upon the highest ground, find our place by taking the bearing of any two or three objects forming the points of our triangles, and laying down those bearings from the objects towards ourselves. We thus ascertain our place correctly if these lines meet, as they will when good instruments and care are used. This practice is common to this method, and that by the plane-table, but the latter instrument does it more quickly and more correctly, being less liable to error than

laying down bearings by a protractor when taken by a compass, thus including the error of both these instruments. The place being found, we proceed as before to draw the contour of the ground, &c., and, supposing a road, house, stream, &c., to be near, we take a bearing to some point upon it, and, pacing the distance, examine the object and mark this point, sometimes taking also a bearing both ways from that place, in the case of streams or roads, and drawing either, as far as we can trust ourselves, while upon the spot. Again, finding our place upon some adjoining feature or height, and doing the same, we join it to what was last done by the eye, occasionally assisted by the instruments; and, by continually keeping upon the high ground, where we can see fixed points within a mile or two, we find our places; and from the places thus determined other points in roads, &c., are found, and the intermediate bends drawn by the eye on the spot; thus ensuring general and also particular accuracy if we please, by a continual subdivision of errors; we also avoid the fatigue and inaccuracy of pacing over unfavourable ground, and save much time by not actually going through the roads as in surveying. But many other things are done as we go on: for example, at the places thus constantly found we intersect houses and other objects, but particularly houses, because they are always upon or near a road, and therefore determine a point of some value in drawing in those roads; and in passing by woods or commons, we always do as much of their boundaries as we can see from that particular spot; and also, if in passing, we are in line with any boundary of considerable length, and nearly straight, although at a mile or more distance, we find our place and take a bearing in the direction of its length, and thus prepare the distant parts of our sketch before we actually come to work upon them. The difference between sketching and surveying, which was said to be exactly reversed, will now be evident, for, in the former we derive the roads, &c. from the hills; while in the latter the hills are derived from the roads, &c. The military officer has more to do with the hills than the roads; if the latter are not perfectly true as to their flexure, so that the former are well connected and expressed, the plan will lose nothing in the estimation of the general, who should, nevertheless, know exactly the state of the roads with respect to breadth and goodness, and the streams as to practicability in fording, their bridges, mills, &c., but the ground is indispensable, and so are the general dimensions of wastes or places fit for encampments, as well as woods and the nature of their trees, whether timber, of what kind, what underwood, and in inclosed countries, the nature of the timber in the hedges, &c.; but these things more properly belong to the written reports that should in all cases accompany plans made for military or political purposes. We must now observe that there will sometimes occur cases in which, from a paucity of points, or when, from being entangled in small ravines or otherwise, many of them will disappear, we are obliged to have recourse to pacing, no other method being practicable; but this does not invalidate the system; for filling in small intervening spaces becomes at length so familiar to practised persons as to present no great difficulty in any case whatever. To avoid this inconvenience, we always sketch around the difficult places, and by invariably diminishing the space, circumstances will always enable us to fill it in by mere reconnoitring; and besides, we constantly determine by intersection, the places of many objects in the parts that appear likely

to produce this difficulty, and thus often avoid it altogether. There is also another case, namely, a flat inclosed country, where we must pace and take bearings, unless we can regularly survey it, for it is obviously impossible to fix points, or find places if they were fixed ; but this will not often happen ; and with respect to extensive forests, it is well known and universally acknowledged, that there is no other way of sketching a country so circumstanced than by examining its parts at such convenient distances as may present themselves, and sketching the mountains by studying the nature of the ground, and its analogy with surrounding features, or those we have seen similar in other countries.

It is evident that much must be done by the eye alone in military sketching. The greatest advantage is to be derived from the accurate use of that organ ; and whenever it saves an instrumental operation we must by no means neglect it. The nature of roads may, in great measure, be inferred from the surrounding soil, for, whatever may be its component parts, they will influence the state of the roads materially, which, for the most part, are composed of materials near at hand ; this is one advantage of knowing, from the configuration of hills and mountains, their probable, we may almost say certain, composition. But, that nothing may be left to conjecture in a case of such importance as the march and subsistence of armies, this subject should always be included in the written report.

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