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WAR MAPS.

By Colonel Sir T. H. HOLDICH, K.C.I.E., C.B., R.E.

Wednesday, 7th March, 1900.

General Sir HENRY W. NORMAN, G.C.B., G.C.M.G., C.I.E., I.S.C.,
in the Chair.

TWENTY years ago, when I last had the honour of addressing an audience at this Institution, that particular branch of the science of map-making which we call "military" was very much better understood by all our Continental neighbours than it was by ourselves. Already a comprehensive system of illustrating the geography of new countries on a scale sufficient to serve military purposes had been adopted by Russia, France, Germany, and America, all of them very largely interested in colonial developments, which was then in full swing, and which with but few modifications is in existence to this day. That system was based on the employment of instruments of which we had no knowledge in England. Chief amongst these instruments was the plane-table; and the plane-table method of acquiring maps (although it had been perfected by English surveyors in India) was not recognised in England. There was nothing really new about it. It is, in fact, a method at least as old as Julius Cæsar. But so little was this method appreciated by us that I could not even discover a rudimentary example of the plane-table for the practical illustration of the subject—I had to get one made. Now, I am proud to think, every officer who passes through any special course of military training in this country knows at least the theory of its use, and very many of them are most accomplished topographers. This is a great advance; but it is not quite all that is wanted, as I will endeavour to show.

A word or two is necessary as to the reason of the non-adoption of the plane-table system in England, as it might very reasonably be supposed that with a highly educated and most accomplished staff of officials to direct our military surveys there must be something inherently wrong about it for it to be overlooked. The truth is that it was not suited for England, over which country a systematic survey on a totally different principle had already been carried; a system which has resulted in the magnificent series of maps which we know as the Ordnance Survey. And as this survey still progresses in the work of revision, it would be manifestly unwise to change a whole system of procedure of which the results are so manifestly successful.

About surveys and maps of the class of the Ordnance Survey of England I have nothing further to say ; indeed, criticisms on my part would be an impertinence. It is to those vast fields of half-explored country which either form an integral part of the British Empire in Asia and Africa, or which so closely border our territories that a military map knowledge of them is essential to our interests, that I wish to direct attention. Here we cannot wait for the costly and lengthy processes which are justifiable in England. Here the governing principles under which we have to work are rapidity and economy ; that is to say, that within given limits of time and expense, we are to do the best we can. It is not a question of turning out the most complete geographical illustration of the land surface that science can devise. It is the question of making the most of opportunities that are often too fleeting, and of turning to account every political or military movement that may lead to a gain of geographical knowledge. I do not mean to say that twenty or twenty-five years ago no such attempts were made. Our records of foreign service are full of the gallant attempts made by officers to acquire map information ; and those officers learnt more of the countries with which they were dealing, and entered more closely into relationship with the people of those countries, than would be considered desirable in the present day. But they worked on old methods, and with antiquated instruments, and it is surprising what an enormous amount of persevering labour was bestowed on results that would now be considered most inadequate.

Setting aside, then, all that class of mapping which is the outcome of elaborate and expensive survey systems organised in times of peace—which class, indeed, includes the whole continent of Europe, and embraces war maps just as much as civil maps—I will say a few words on the two branches of my subject which seem at present most in want of illustration.

First, What are war maps ? Next, How are we to get them ?

War maps, or military maps, are obviously those which serve the ends of a military commander either for the comprehensive purposes of strategy, embracing large square areas of country ; or for the more local object of illustrating offensive and defensive positions, fields of action, sites for military stations, etc.

In dealing with wide areas to be embraced by an extended plan of operations, military authorities want to know, not only the position of large features, such as rivers and mountains, main roads, and centres of supply ; but they want also to know what is practicable ground for manœuvring troops over ; the position of every ford, or pass—in short, every local detail which may be turned to advantage either for offence or defence. Large spaces of country may be comparatively unimportant, whilst special accuracy may be wanted only along certain lines ; but, in any case, a general geographical map is essential.

Now, if you ask any administrator of the out-of-the-way regions of our Colonial Empire who is sighing for a map of his country and cannot get it, what it is that he wants, he will tell you almost exactly the same thing. He wants to know what are the best lines for prospective roads

and railways ; where are the limits of the agricultural and profitable part of his domain ; what is the nature of the mountains and forests ; what is the varying level of hills and plains above sea ; and how he can best strike at any part of his province, where the weight of his administrative authority requires to be felt.

Again, ask the political officer on the frontiers what are his requirements, and there will be no great variation in the reply ; chiefly means of communication unravelled ; tribal limits ; and a few special topographical particulars, added to a general survey. And, if he happens to be a boundary commissioner, he wants accurate ethnographical details, based on accurate topography, along a special line ; that is to say, he requires minute accuracy in one part of the map, and general geographical detail elsewhere.

Thus you see that, whilst a war map of a country at large should be based on surveys of an elastic nature, admitting of rigid accuracy in important districts, and of a general geographical sketch in those parts where physical conditions render military movement impossible, we find that the administrator, civil or political, requires almost exactly the same thing ; and the boundary commissioner only differs from both in that he would apply the test of accuracy to regions which may not necessarily be considered important by either soldier or civilian, but which, on the other hand, may certainly be of the very first importance. Remember that we are dealing with the question of the first general map of any country—that class of map which is so urgently needed in South Africa at the present moment, and is so lamentably wanting. What, then, is the difference between a civil map and a military map under such conditions ? If their interests are separable, where do you draw the line ?—and what are we to consider the class distinctions ? I have been puzzling over this question for thirty years, and have found no answer. And yet I have known of correspondence, which might almost be called acrimonious, passing between our highest civil and military authorities on this subject, when once the question has been raised Who is to pay ? The fact is, that when we are at peace we cannot imagine that we shall ever want military maps at all ; but this is a want of imaginative power which does not extend beyond England ; there is no other civilised country in the world with military instincts that does not recognise the principle that a geographical map of all country which comes within the radius of military vision is a primary necessity.

I believe that the inauguration of a systematic attempt to attain sound geographical maps of all countries with which we have to do must be based on this one fundamental principle, *i.e.*, that the business of acquiring such mapping is neither civil nor military, but Imperial.

But it is not in England only that there is confusion between civil and military interests in the matter of geographical mapping. It exists in India to this day. Twenty-two years ago, at the earnest solicitation of a surveyor-general, who has left behind him a reputation as a practical military geographer as well as that of a scientific surveyor, a detachment of professional surveyors from the Indian Survey Depart-

ment (which is a civil department) were attached to an army in the field as a sort of scientific adjunct, to pick up new facts about Afghan geography. That such geography could be of the least use to the commander in the field was not in the least anticipated. But even with the disadvantages that attended those early experiments, the waste of time in map reproduction, and in endless references to a chief who was in Calcutta, instead of a chief who was in Afghanistan, the rapidity and certainty of the Indian system of surveying was very speedily recognised, and at the present time no military force of any importance ever takes the field without a survey party attached as a professional unit. Yet still the civil status of the officers employed in this most essentially military duty is always carefully maintained. They are not combatant officers. They may not command their own escorts. They may or may not be recognised by the chief in the field as a part of his staff. This is because the Indian Survey Department is largely a civil department as regards its *personnel* and its objects; and no exceptions can be made in regard to those geographical or military surveys which cover vast areas of the peninsula but pay nothing into the British Treasury.

Assuming then, as I think we may, that the first general military survey of a country is a geographical survey just as useful for civil purposes as for military, on what scale should such a survey be carried out?

I have already pointed out that there should be no rigid adhesion to any dogmatic rule of either scale or standard of accuracy in such work. Herein lies the art of the surveyor. It would be ridiculous, for instance, to make maps of the vast wide desert spaces which border the Nile on the same scale as those of the Nile Valley itself, and it would be equally absurd to waste time and money over all the narrow little intricacies of a mass of mountains which could lend themselves to no possible military manœuvre, as on the important details of the cultivated valleys which they enclose. Nevertheless, we must have square maps which include everything. Blank spaces in maps are an abomination, for they lead to conjecture; so that the first principle of a geographical map which has to be rapidly completed is elasticity of scale. For a general map which is to show roads and communications both important and unimportant, defensible positions such as isolated hills, or deep ravines, river windings and possible crossing places; which is, in short, to guide a general in the movement of large mass of troops, the scale of one inch per mile is generally found sufficient. I have made such maps on double the scale, *i.e.*, two inches per mile for the special purpose of military manœuvres in very intricate country such as exists around Quetta, and in the extraordinarily rough country near Rawal Pindi. The two-inch maps were much appreciated, but there was a final re-action in favour of half that scale, which was found to be quite sufficient for all practical purposes, and very much handier on account of the larger area which was included within a given sheet. Of course, military mapping may run to any scale, but we then leave the general map and approach special maps of position. Such a map as a one-inch map would, in South Africa, for instance, show

every kopje, and every detail of importance. But then South Africa is an ideal country for the surveyor, and there are not many like it. But half that scale, even a quarter that scale, is capable of effecting great things. All the mass of rugged mountain frontier which extends from Quetta to the sea has been surveyed on the scale of half-inch per mile, and the scale is ample to reveal to us a whole array of unguessed-at, unimagined, facts of great importance about a district which had been to us from time immemorial a land of impenetrable mystery. But the normal scale of all our Indian trans-frontier work is half that again *i.e.*, quarter-inch to the mile, and I regard it *par excellence* as the scale for the first military geographical survey of any country which is so far varied in topographical form as to exhibit alternate hills and plains. This means most of the unmapped country of the world. It is capable of great accuracy where accuracy is necessary, and it admits of extraordinary rapidity in delineation in the hands of an accomplished topographer; as you will understand when I tell you that on this scale any really good performer can survey all that falls within the range of his vision as he accompanies a force marching at any rate less than twenty miles a day, and that his out-turn in fairly easy country may be from one hundred to two hundred square miles per diem.

You will say that such surveying as this cannot be of much value. I assert again that a good quarter-inch plane-table survey will meet more than all normal military requirements. It will even serve special purposes. It was long a matter of argument between the Russian topographers and ourselves on what scale the Russo-Afghan boundary maps should be constructed. They held out for elaboration, and the scale of half-inch per mile (or as near it as Russian scale dimensions allow). I had neither men nor time to work anything larger than quarter-inch. The final result was that, though the Russian topographers adhered to their half-inch maps, it was the quarter-inch that finally served diplomatic purposes best, and was adopted as the standard for reference. I may mention that three officers and three native topographers (afterwards increased to five, when special maps were required) completed one hundred and twenty thousand square miles of geographical mapping in the course of that single boundary commission, besides special maps of Herat and the Oxus regions. Descending still further to the one-eighth-inch per mile scale, we still have the possibility of much useful work in open country under conditions in which any larger scale is impossible. I am talking now of surveys, not of mere reconnaissance, but of actual mapping securely based on a framework of points fixed by triangulation, but where triangulation is so scanty, and points so few, that it takes the smaller scale to bring them into the space of a negotiable sheet of paper. Under these circumstances, given a well-trained surveyor, with perfect freedom of movement, and it is difficult to set limits to the possibilities of his out-turn. I have known an exceptional expert at this sort of work, in Eastern Persia, cover upwards of fifty thousand square miles in the course of seven or eight months' journeyings, and absolutely leave no important feature unrecorded.

Granting then that a strategical war map is a geographical map, a civil administrative map, only with special attention paid to certain details, how are we to get these maps? What are the conditions, first of all, under which they can be made? No doubt the condition of free access to a country, and the right to move about it without hindrance, is the condition which leads to the best results. It is under such conditions that the one-inch maps of all the continent of India that does not pay revenue have been completed. Under such conditions a uniform standard of accuracy can be maintained, and that standard should be a very high one. But it is not always possible to secure such conditions, and it is almost always under other conditions that war mapping is most urgently required. Without the actual processes of a campaign in face of an active enemy, there may be deadly hostility to the surveyor; a determination not to allow the veil to be lifted from the face of Nature in such a way as to give advantage should war operations ensue. Where such opposition is organised and systematic it may absolutely prevent further survey proceedings; as is the case in Afghanistan, where there are still a few comparatively unimportant gaps to be made good in our map knowledge to this day. But where such opposition is not organised, as would be the case in many a district occupied by hostile tribes in Africa, and is now the case in many a district beyond our Indian frontier, it merely becomes the normal condition under which we may expect to work. It is under such conditions that a great deal (indeed most) of our geographical mapping in Asia is effected. It demands a special class of workmen—men who know the countries and the people with whom they have to deal; natives, for the most part, who understand the venal working of the Oriental mind as well as they understand the use of the plane-table. About these surveyors we never say much. Their names are not known, and they neither talk nor write anything except their reports. They are specially useful on political missions.

But the one condition which after all affords the most certain prospect of a large accession of geographical map-making, is the actual progress of a military expedition or of a campaign. There is no uncertainty then. The surveyor can go wherever troops can go, and he can even survey a very large extent of country (and this is the point to which I specially beg your attention) beyond where troops can go. It was at first thought necessary that the enemy's country should be securely held before the military surveyor commenced his operations—that he should always act in rear, so to speak, of the advance. No general officer looked to the professional surveyor to give him a map of the country in front of him; and, it must be confessed, that the delay in the reproduction of the field maps when the system of attaching professional surveyors to a field force was first adopted, justified the prevailing idea amongst the military leaders of our frontier expeditions that all they could hope to get in return for the assistance given, and the risks run in the matter of escorts, was a map which, after the whole campaign was concluded, would illustrate the nature of their proceedings. And inasmuch as I am certain that this is still a prevalent idea, I beg permission to enter rather more fully into

the details of this part of my subject than can be permitted elsewhere. What I maintain is this : A good professional workman should not only illustrate the actual course and progress of an action whilst that action is taking place, but he should be able to put into the general's hands a certain number of copies of his illustration, showing precisely the nature and direction of each movement ; the position of artillery ; the ranges and altitude of each prominent point, and a general roughly contoured plan of the whole position by the evening of the day following the action, provided he has sunlight sufficient to help him in printing his copies. Such illustrative maps as these are of course of a special character, and on sufficiently large scales to suit the subject. More than this. If the country is at all hilly, he should be able to indicate the position and height of the hills in advance to a distance of at least a day's march, noting the lines of drainage, the position of roads, passes, and villages ; fixing the relative altitudes of all notable features, and placing it absolutely beyond the power of any guide to mislead a column (even on the darkest night) within the limits of the ground that he can see from the highest points that he can reach. And here I would note in this connection what splendid assistance could be afforded to the surveyor by the balloonist and the camera. But this is so much of "another story" that I must decline the fascinating speculations to which it gives rise.

I do not think that this faculty of surveying ahead of a column is at all understood or appreciated. Many a general is still left to such intelligence as may be gleaned from untrustworthy native sources, or from a reconnaissance conducted along a road from which nothing can be seen, to obtain the necessary clue for an advance or a surprise.

It may be objected that such small scale geographical maps as are the only possible ones during rapid movement can hardly show detail enough to be trustworthy guides to movements over ground as yet untrodden by scouts and held by the enemy. I reply that though the scale of mapping may be small, the surveyor knows and observes far more than can be expressed by the scale, and this knowledge should be at the general's service as much as his map. I will give you an illustration. We were at the back of that magnificent mass of frontier mountains known as the Takht-i-Suliman. We had arrived at the back with much difficulty, over a route which no force had ever attempted to negotiate before. The enemy were on the top of the mountain thousands of feet above us ; supplies were short. We had just three days in which to beat the enemy and reach the highest peak of the mountain (eleven thousand three hundred feet above sea), before it would be absolutely necessary to turn our backs on it, and go back again. We all knew what going back through those defiles with an unbeaten foe on our flanks meant. There was only one known way up the scarps and cliffs of the giant Takht, and that way was a narrow one. It was not a ramp, like Dargai, for instance. It was a chimney, a cleft, up which no man could pass without climbing, and no two men could possibly go together. Our guides and our friendly counsellors sat about and grinned, and the people on the top, with their carefully arranged obstacles and their piles of loose rocks, danced their

war dance and hurled defiance at us down the wind. The guides, of course, knew no other way than the way they took exceeding pride in pointing out to us. But the process of running a quarter-inch survey revealed many more facts than could actually be recorded on the paper. The map showed a break in the line of cliffs some three or four miles away, where a landslip occurred, and it showed that a line of drainage must certainly start from under that break and join the main stream at, or near, our position. All this was expressible on paper. But the paper would not show that a few broken juniper trees lined the cliffs above the nullah some two miles from camp, or that the flashing light on the distant weapons of our foes as they danced, a light which could be seen as far as the break in the cliffs, indicated some sort of a pathway between that far point and their main position. The deduction was comparatively easy. We waited till our guides were fast asleep, and then stole out into the nullah-bed with a party of four hundred Sikhs. Many weary hours of shin-breaking climbing during the small hours of a nearly pitch-dark night, during which we might have imagined that we were lost, but for those juniper trees, was rewarded when the dawn broke. When the pale yellow streaks of western sky first silhouetted the ragged outlines of Shinghar behind us, and the passing rustle of the cold morning breeze carried along whiffs of pine and fir, we were crawling up over the last slopes of that abominably broken ramp. By eight o'clock, when the first shell whistled up and burst over our heads to warn us that the direct attack had commenced, we fell upon the enemy from behind; and from that day to this the Khedarzais have ceased from troubling.

Once again, in Waziristan, it happened that whilst taking a round of observations with the theodolite from that magnificent peak Shuidar, there crossed the field of the object glass a strange procession of figures, all armed to the teeth, making their way to a comfortable position for an ambuscade in advance of us as we passed through a stiff defile below. With the plane-table it was easy enough to point out a certain and safe line of mountain ridge and spur which a detachment could follow, and which should lead to the ambuscade of the ambuscaders. Thus a double ambuscade was laid, one above the other; and this eventually saved us much inconvenience and trouble, and led to considerable loss to the enemy. But little successes like these are soon forgotten, and it is only when an untrustworthy guide leads a force to disaster that we ask whether it may not be possible to make our own maps and to guide ourselves. It always seems to take a disaster to point a military moral.

But when an active enemy is absolutely occupying the field, so closely hidden as to be invisible, and so active as to outpace the quickest movement of the surveying party; when he is armed, moreover, with the best of modern weapons and knows how to shoot, there certainly does occur a substantial difficulty in reaching positions far enough from the main force and sufficiently prominent to afford good posts of observation for survey work.

I admit the difficulty, but I would point to the map on the screen before you. It is a rough trace (a very rough trace) of the Tirah mapping,

most of which was done under those very conditions. There are between two thousand and three thousand square miles of mapping on the sheet on the one-inch scale, and you will see that it is closely packed with hills, ravines, nullahs, and mountain roads, rendering it almost as intricate a piece of mapping as could well be made in the face of a very pertinacious and active foe. Experts will probably detect a weak point or two, but there is only one of importance, and that was not due to the aggressiveness of the Afridi, but to the fact that one or two marches were made in blinding bad weather, when it was impossible to see the tops of the hills flanking the Bara Valley. All the central part of the map, Maidán, Mastúra, Warán, etc., was mapped by three native topographers, one of whom was a Pathan sepoy with a genius for topography, and a contempt for the Afridi, which we did not all share. It happened that he, working with Lockhart's force from east to west, overlapped the borders of a Gurkha surveyor who was with Hill's brigade in the Kuram. They did not quite agree. The disagreement was almost infinitesimal and of no possible consequence. But they were ready to fight at once in defence of their respective reputations for accuracy, and I was really afraid they would fight. Of course, the native topographer cannot be left to his own devices. He must be directed and supervised by officers who can arrange for his escort; insist on his reaching the point he wants to reach; collect information; observe altitudes; triangulate if necessary, and generally find the means and watch the opportunity for working. This the native surveyor cannot do for himself, and whether you have one or twenty professional topographers in the field there must be superintendence on the part of trained officers, as active and keen as themselves. And there is also the all-important question of escort to be arranged. Happy the man who on these occasions obtains an escort of Gurkha scouts. They delight in the work. Mountaineers and sportsmen from the cradle, they will scatter up a hillside without giving a sign of their existence. They will hold on to secure cover, and protect the plane-table from the gradual concentration of long-range fire to the very last minute; then giving the carrier of the instrument a fair start down hill, they will scour down after him in a scattered covey with a rapidity that even the Afridi could hardly match. Unhappy the man who would attempt the same performance with a British escort. The British soldier is not built for it. Boots and rifles and ammunition and want of breath all tell too much against him, and the handicap is not a fair one. This interesting process of surveying in Tirah resulted in the plane-table being twice hit, but nothing worse happened.

Now as to the quality of the mapping so attained. No important road or pass or mountain spur or ravine has been omitted, and as far as possible every homestead in those thickly populated valleys of Mastúra and Maidán has been indicated. But there were so many of them, so closely packed, that I cannot vouch for it that they are all there. The map will at any rate illustrate the soundness of the plan of approach to the country; an approach which led us] over three passes, it is true, but which struck at the

heart of the country by the shortest route, and which left us (after the subjection of the Orakzais) with less than two miles of communications to guard between the Arhanga pass and the main camp. You know what happened within these two miles of fairly open route dominated by the pass. Think what *might* have happened had this route been spun out into some twenty or twenty-five miles of enclosed nullahs, as some wise critics suggested that it should have been. Lest you should think that the very rough trace indicates a want of artistic skill, I have pinned up a blue print of a part of the original that you may judge of the quality of the topography. Remember that practically three or four native surveyors completed the whole of it in less than three months.

It is time now to turn to the question of how such mapping is made. I am not going to trouble you with technical details. It is simply topography (plane-tableing) based on triangulation. Consequently, triangulation is first wanted. I have already pointed out that in thickly populated and highly cultivated countries this triangulation must be rigidly accurate, starting from a scientifically measured base, or confusion and litigation will inevitably ensue. Such triangulation (which we will call geodetic) besides serving actual geodetic purposes, should always be the basis of a wide extension of that class of triangulation which supports this topography. It is in fact not only half, but the best half of its justification for the expense and labour bestowed upon it. But this purpose of it is sometimes missed, and it is a curious fact that with a splendid system of first-class triangulation extending through South Africa, from the Cape to the Transvaal, leaving nothing to be desired in the matter of abstract scientific requirements, there are not only no military maps of the Cape Colony, of Natal, or of the Transvaal (except the corner surveyed by Major Grant), but no secondary triangulation on which to base them. Where such secondary triangulation does not exist, survey officers must make it for themselves as they move along. Fortunately South Africa is an ideal country for surveyors. With the accessories of railway lines (which furnish admirable bases) and the advantage of telegraph, for longitude determinations, our war maps should be turned out at the rate of thousands of square miles per month. They *should* be; but it is hardly likely that they *will* be, for we now come to the one consideration which involves the point and the moral of this paper—the consideration of who is to make them.

I have already referred to the necessity for the supervision and leading of trained officers in work of this nature. I need not refer to it further than to say that there is never likely to be a lack of such officers. Even if the great fields which are open in Asia and Africa did not always supply a number of officers with all the necessary experience, the admirable School for Surveying, which now exists at the Engineer headquarters, under Major MacDonnell, would make good the deficiency. But as a matter of fact we have a splendid roll of names of men who have already distinguished themselves in the field of military surveys, and there seems little chance of any such deficiency. There are four officers

at present in South Africa, of one of whom, at any rate, it may be said that he is a past-master of the topographical art. But the best of all good officers cannot make bricks without straw. They cannot cover large areas with accurate and skilful mapping without a staff of *professional* topographers. And where are we to find them? In England they do not exist. In Russia they may be found at Tiflis, and beyond Tiflis they may be found spread abroad through all Central Asia. In India they may be found everywhere. India could not get on without them. In France, in America, in Germany, they are to the front wherever colonial possessions have to be mapped; only in England they are not, and they never have been. Our Ordnance Survey companies do not possess them, for their survey system is different, and their work is not of the nature about which I am now speaking. It is to the fact that we have not got them; and that our generals do not ask for them, because they have no experience of them, and do not even know what they are, that I specially invite your attention.

What is a professional topographer? He is a man who makes topography his speciality and his profession—who devotes his life to it. He may be European or native—each has his special sphere of action—but he is as truly a professional as is the artist who hangs his pictures on the line of the Royal Academy Exhibition. In India they are taken young, and they are often brought up in an atmosphere of map-making, and often the faculty is hereditary. They begin with line drawing and printing as soon as their hands are steady enough to draw. They copy maps for years before they make them. They are next introduced to practical work under efficient training, and for years again may go about the country—a country of mountains and plains, of forests and dales and rivers and thick cultivation, with the plane-table as their companion. Then they get drafted into a survey party on regular pay; or, if they are Europeans who have done their schooling, they pass a fairly stiff examination before they are appointed. Having joined a party in the field they have four or five years of hard topographical practice in the field before they are trusted to draw a fair map. Supposing they are soldiers (as many of them are), they are first selected in their regiments for their natural aptitude at the work; they are then sent through the Rurki schools for survey training, and at the conclusion of the course one or two out of a class of twenty show that they have the topographical instinct in them. These few are then possibly attached to a frontier party, and the real training begins and lasts for some years. Finally, out of fifty who originally started, some four or five turn out to be men of the stamp we want—men who fear nothing but will dare everything; who will explore, and map, and tell the truth fairly often, and not talk unseasonably; devoted to their work, and devoted to their officers. I have said much about the natives and too little about the civil European staff. Amongst them we have had splendid men, men of the stamp of G. B. Scott, of Afghan fame, or McNair, who, alone and disguised, mapped the route from India to Chitral long before our troops ever passed that way, and penetrated into Kafirstan; or Claudius (an Eurasian), who

adopting the guise of a Shikari went on a survey quest to Tirah (though not exactly by the route we subsequently followed) and gave us the key to the gates of it. But these men are all *professionals*; they do one thing all their lives and they do that one thing well. Splendidly appointed as is the Russian topographical staff, I believe that ours in India is better still.

If we possess a trained staff in Asia, you may say, Why not apply them to Africa and the world at large? To a certain extent this has been done. Indian surveyors have done well in Africa already; but it must be regarded as an experiment, not as a system. India has her hands too full of her own work to spare many such men, and under no circumstances can she spare her best men. Every High Commissioner in Africa knows now what professional topographers can do, and asks for them. Already geographical surveys are being started in all directions with most inadequate means. The Surveyor-General in India has found it to be beyond his power to meet all demands, and the Indian Government does not encourage him. "If you have men to spare for Africa," they say, "you have obviously more than you want in India"; and the scissors are forthwith applied to his budget estimate. And it must be admitted that it is most inconvenient to part with good men after all the trouble and expense in training. From my party in India one of the best went to the Amir of Afghanistan, who offered him just ten times the pay that the Indian Government gave him. Another is now a sort of Surveyor-General at Zanzibar, much decorated and in high honour. A third went to the Kashmir durbar, and I saw him no more. Half-a-dozen or so went to Central Africa, and they came back; but they insisted on coming back, in spite of all the temptations of high pay. It is not every Indian who cares for Africa.

If we cannot have Indian topographers, how are we to obtain them? The solution of this problem does not appear to me to be so very difficult, if we are only content to wait. It resolves itself into this: Let us train our own staff of professional topographers just as every other country trains them.

There need not be many of them. A half-company of sappers would amply supply the wants of all Africa if combined (as in India) with a native civil staff. As we have survey companies, railway companies, field telegraph companies, and special companies of all sorts, why not have a half-company of professional topographers? They must be picked men with a special training, and they must be topographers and nothing else. I am not in the counsels of the War Office, but surely there should be no difficulty in the way of starting such a scheme at a time when we are starting so many others. It is not unimportant. A body of men (even five-and-twenty would be of great service), who in times of war could make maps such as I have described to you, and who in times of peace could be responsible for the direction of native detachments all over Africa, would make all the difference in our map knowledge of that vast new world, and keep us at least level with the acquirements of our neighbours. Their training is a matter of detail into which I need not enter

now. In addition to this military force, there should be in every new African province a local corps of native topographers. This is a geographical factor which I hope to see further developed ere many years have passed; for all good authorities agree that certain natives of Africa possess all those natural qualifications which combine to make a good survey workman; and that they take kindly to instruction under European direction. They could be taught, as a commencement, in the Indian schools. I feel sure that the Indian Government would welcome such a scheme, provided that no great expense was involved which would have to be met by the Indian Treasury. But I cannot and need not enter farther into schemes which still require attentive consideration as regards details. They are not ambitious schemes, and they are not expensive; and they are, I trust, practical. If you regard the question of expense too seriously, remember that a few miles of bad alignment may cost as much as a whole line of railway; a boundary based on apocryphal geography may cost a war; ignorance of a few miles of country may cost us battalions and lead to disaster.

Sir CLEMENTS MARKHAM, K.C.B., F.R.S. (late R.N.):—Sir Thomas Holdich has undoubtedly raised a question of very great importance. He wishes to extend to all the Colonies and Settlements under the Crown the great benefit which is derived in India from the excellence of its Survey Department. That Survey Department is now a hundred years old, and during all that time it has been doing most admirable and most difficult work. It was not until lately—and by lately I mean the last forty or fifty years—that the topographical work beyond the boundaries of India was closely attended to; first, by that great surveying officer, to whom the lecturer has alluded the late Colonel Walker. Sir Thomas Holdich has followed in the footsteps of his former chief, and now a surveying party with an army in the field is not only tolerated, but considered necessary. In India, as the lecturer has told us, they have carefully trained native topographical plane-tableers, or topographical surveyors. In several Colonies we have Surveying Departments, but we have no staff of trained topographical surveyors. I think we must all have been astonished at hearing of the want of maps during this South African war, and at the very serious consequences arising from ignorance of the topography of the country; and yet we know that there are Surveying Departments in most of our Colonies. There is a first-class system of triangulation throughout Cape Colony, but no good topographical or military maps. I believe there is even a Surveying Department in the Orange Free State. We had heard so, and we wrote and asked them for the sheets of their survey. With that "slimness" which is peculiar to the Boer they sent us a small, useless, general map which we could have bought in London. Therefore, we do not know whether they have commenced any survey or published any sheets or not. Now there can be no doubt that it is of the utmost importance to geographers, to administrators, to political agents, as well as to officers in the Army, that there should exist topographical maps by which they can be guided, and that generals should not have to depend upon incorrect information obtained from guides in the country. Sir Thomas has very properly pointed out that the very same requirements are wanted for a military as for an administrative, a political, or a geographical map. That being so, he certainly ought to have the support of all geographers in his endeavours, and I am convinced that the Council of the Geographical Society will give him that support to the utmost of its powers. I cannot believe, now that official eyes are opened to these wants, that he will find great difficulty when he approaches the military authorities on the subject. Anyhow, if he succeeds in his endeavours to establish trained topographical

surveyors throughout Her Majesty's dominions, as well as in India, he will have done a very great and important service to his country.

Major H. T. CROOK, C.E., 1st Lancashire Royal Engineers (Volunteers):— I have been extremely interested in this very able paper of Sir Thomas Holdich. I have made very frequent public appearances as a critic of our Ordnance Survey, and this paper is peculiarly interesting to me, because Sir Thomas Holdich dwells so much upon topography as an art and the necessity of training professional topographers, and the curious thing is that if this paper had been read fifty years ago there would have been a larger number of people in this country able to appreciate its value and the subject of topography than there is any chance of there being to-day. Fifty years ago this nation may have been said to almost lead the world in topography and topographical representation. To-day it is a generation behind the world, and the great difficulty, as the lecturer has said, is to obtain men who are trained topographers, because our Ordnance Survey ceased to be even artistic in the maps which it produces. It started as a Topographical Survey over a hundred and twenty years ago, for military purposes and military maps. What is good for military purposes is good for civil purposes. If it is a good military map, it is good for all civil and geographical purposes. And had the policy been continued, with which the British Survey was started, we should have certainly many more topographers than we have now. But there is another point, that, although we started one hundred and twenty years ago with topographical survey, at the present moment there is no uniform topographical survey of the British Islands yet completed. The style has been changed, the process with which the map is produced has been changed, and the work is extremely discordant, inharmonious, and in many parts of the kingdom thoroughly inefficient, and some of the new maps are the worst that have ever been produced. Some few years ago it became part of the examination of officers, when they attained the rank of major, that they should undergo an examination in the field on their faculty in reading maps, identifying points of localities and positions distant and close at hand. In many districts in this country an officer has been taken out for an examination of that kind, where there has been no map in which the features of the country are correctly delineated. The position of the places, geodetically speaking, is correct, and the hill sketching, the drawing and representation of the ground, or what is left of it, is quite capable of being understood; but certainly it would be impossible for an officer to identify many distant points from the map which was before him in such places as Cheshire, for instance. I agree cordially with Sir Thomas that this matter of topography is a professional matter, and that a man requires to be thoroughly well trained, but it goes further than that—that when you have your maps you want to have men able to interpret them and read them quickly; and unless you have the topographical materials and the good maps you will never have good topographers, you will never have men who can readily comprehend the situation and the ground. Sometimes the knowledge of topography, that is, the comprehension of ground, comes almost intuitively to a great many people; to others it can only be acquired by the study of good maps which represent the features of the ground. A man versed in topography recognises the character of the country he is in, and even without a map has an intuition of what he will see a few miles in advance on either side of him. An ordinary man, an officer, or whatever he may be, who requires to use maps, needs a certain amount of training in reading them. Therefore we want not only to train professional topographers—and I hope we shall see them trained in this country—but we want also schools of topography such as they have in France and Germany. If we look at our military books and atlases that come out, we see they are simply scandalous. Take any recent book that has been published, the translation, for instance, of von Hoenig's "Life of Cromwell," the maps in that are simply abominable, as they are in Dr. Gardiner's

"History of the Great Rebellion." This is an exceedingly interesting subject to most of us, and yet the maps with which to follow that campaign are lamentable. There are really no good topographical representations even of the ancient battle-fields, which are so numerous in this country. I do hope, Sir, that this lecture will do something to stimulate the study of topography, and also to bring before the authorities in this country the necessity of really restoring the topographical section of the Ordnance Survey, which, of course, is the one we must depend upon for the education, not only of topographers, but of people in their appreciation of topography. It is no more necessary for a man to be a professional topographer to understand maps than for a man to be a professional musician or professional artist to understand music or pictures.

Mr. A. SEDGWICK WOOLLEY :—I should like to say a few words in regard to the remarks of the lecturer that "the first general map of any country—that class of map which is so urgently needed in South Africa at the present moment, and is so lamentably wanting." That it has been wanting by the military authorities is true; but whose fault was it? The maps were procurable, yet were not got by the Intelligence Department. Maps of the Orange Free State have been made; every farm has been trigonometrically surveyed, and every drift, kopje, farmhouse, pan, and stream is shown on those maps. I can vouch for this, because I am a Kimberley surveyor, and I have had a good deal to do in the Free State in reporting upon diamond and gold discoveries. About three years ago a Johannesburg syndicate employed me to report on a long line of gold reefs which exist about forty miles to the west of Kroonstad. I told them they had better procure any maps they could from the Orange Free State to assist me in making my plans and report. They sent to the Government mapmaker at Bloemfontein, Mr. Herfst, and he supplied them with large scale maps, which showed the whole topography of the districts required. Afterwards I was interested in an endeavour to obtain a concession for a line of railway from Kimberley to Bloemfontein, and we got the maps from the same quarter by simply paying for them, and they showed everything in the districts from Kimberley to Bloemfontein, such as would be wanted in a first general map of the country, quite enough for military purposes. I think, in the first case, some £40 or £50 were paid, and in the other probably £70 or £80 for the maps. The different district maps of the whole of the country could be obtained thus. Sir Clements Markham has referred to the map which was sent by the Orange Free State to the Geographical Society. I have seen that map, and I notice that everything of importance is carefully left out. Probably it was sent as a present, and therefore they thought they would not supply any information; but private individuals could get those maps by paying for them. Therefore, the question comes in, as Sir Thomas Holdich says, Who is to pay? If private individuals, merely for the purpose of making money, can get them, why should not the Government have got them? Perhaps they thought that maps were of so little importance that it was not worth while obtaining them. We in Kimberley told them, the authorities, three years ago that we were going to have a fight with the Orange Free State, and we were laughed to scorn. I do not, however, want to enlarge upon that, as it is foreign to the paper. When Sir Charles Warren came out I put myself into communication with him, as I happened to have had the pleasure of working under him as Assistant Boundary Commissioner in the Bechuanaland expedition, and he wrote and asked me whether I could give him any maps of the Orange Free State. I had certain maps myself, and through a commercial institution in Cape Town, which lent money on properties, I obtained other maps which supplemented the whole of the maps of the Free State, and those maps were reduced and connected in one map by some mapmakers in Cape Town, and they are the Intelligence Department maps of the Orange Free State which are now being sold at Stanford's. They are, as preliminary maps of a country, I think, quite sufficient for military purposes, and without them I do not believe that Lord Roberts would have known the De Kiel

Drifts and the drift at Waterfall, on the Riet River, or those at Rondewal and Klip Drift, on the Modder. These were all shown on the maps. I, with other surveyors and men of experience of the country, said four months ago that the only possible plan of attack was to make a flank movement on Bloemfontein in that direction; but our generals had no maps showing the drifts and easy nature of the country. Had they had those maps, which are made to a scale of about half an inch to a mile, a compilation of them would have helped them out of their difficulty. It would have shown what they could do in the way of a flanking movement. It certainly would have been impossible to make a flanking movement without cavalry or mounted infantry, but it would have shown the absurdity of attempting to make a frontal attack with infantry over a river fifteen feet deep, such as the river below the Modder River Bridge. I see that Sir Thomas Holdich has left out the question of the use of the prismatic compass entirely. I myself am a great believer in the prismatic compass for preliminary survey. When I was on the Boundary Commission, we used the theodolite for primary triangulation, which we supplemented with the prismatic compass for fixing minor points and the plane-table for filling in. The plane-table is a most excellent instrument for filling in, but for rapid work I believe in the prismatic compass very much. I was the Secretary of the Bechuanaland Land Commission, and after the settlement I particularly pointed this out to our Administrator, Sir Sidney Shippard, and our Surveyor-General, when they wanted to give out some forty-four farms along the border of the Transvaal for military occupation. Our Surveyor-General was an old naval man, and he ridiculed the idea that you could use a compass with any degree of accuracy on land. I assured him that I had used it a great deal, and that though I knew there were kopjes where ironstone existed on which a compass could not be used, still, as a general rule, you could get very accurate results with it for preliminary work. I got them to agree to it, and I made the preliminary survey of those forty-four farms entirely with the prismatic compass, and pacing. The Surveyor-General said he would allow me in each farm of 3,000 acres an error of 300 acres either way, but when they were actually surveyed with the theodolite we found the error as a rule only amounted to about forty or fifty acres, an inappreciable difference on a scale of half a mile to an inch. Therefore I say that the prismatic compass is a very excellent instrument, and I was rather astonished that Sir Thomas Holdich had not mentioned its value for rapid work. Another matter I would touch upon is the use that can be made for rapid work in sketching roads. Wherever I travel by cart in South Africa, I always make road sketches, because you generally have drivers, either Dutchmen or natives, whom you do not care to talk very much to, and it fills up your time, besides forming a most useful record. I use a field note-book, lined with ordinary blue lines, and count the lines as two minutes apart. Wherever you start from, you put down the time, and sketch the road as you go along, marking all details for each two minutes, and from that you get a very good idea of the country. I have the whole of the road thus sketched from Modder River Bridge to Koffyfontein, with the drifts and cross-roads and every little kopje marked, marking with blue pencil anything in the nature of a water-course or a river, and with a red one the hills, and giving their approximate heights. In that way, where you have maps already made, as we have, of the whole of Cape Colony, the Orange Free State, and the Transvaal, military officers could verify and amplify them for military purposes by driving about the country and filling in details by road sketches.

Colonel G. E. CHURCH (late U.S. Army):—The sound reasoning of the paper and the thoughts which it evokes, recall to my mind my own modest military experience in the Army of the Potomac and elsewhere. In Virginia, our ignorance of swamps, forests, creeks, and rivers was such that we lost many thousands of lives in our efforts to reach Richmond by the way of the peninsula. In general, where ignorance prevailed as to the country which we wished to invade or defend, our armies were not always organised to suit geographical or topographical requirements, and upon

our generals devolved the heavy task of trying in face of the enemy to correct the errors which had been made at headquarters. I have listened to the previous speaker with a great deal of attention in regard to what he says of the prismatic compass. I have done a great deal of work with it myself; but in connection with an odometer, which is simply an instrument with a wheel for measuring the length of a road. Supplementing the plane-table with it, I should say that the two instruments would serve to map any area of new country for military purposes. I have no doubt that, under certain conditions, the plane-table would be superior to the odometer and the prismatic compass; but the plane-table, I take it, would be better in a rough, dry, little-forested country. A plane-table map, of course, grows under one's eyes, but if you have many rainy days you lose a good deal of time; while, with the odometer and compass, you can run along whether it rains or not. I have mapped hundreds of square miles with an odometer with great rapidity. I should say that in a new region where one is undisturbed by an enemy, a man could do the field work for a shilling a square mile, and doubtless for more or less the same cost with a plane-table. Therefore one fails to understand why we recognise it to be the first duty of an army corps to study geography in face of the enemy, at great cost of blood and money, when, with two or three topographical engineers, we could map the district at an infinitesimal cost before war commenced. Every day, in this broad Empire, some flash tells of frontier friction and the imperative need of a thorough knowledge of the geography of the land where it occurs. How easy it is to obtain that knowledge in time of peace! Who can estimate its cost in time of war? The thoughtful paper of Sir Thomas Holdich, so full of valuable suggestions, seems to show us that geography is perhaps the primary factor of victory in all important campaigns, and that more attention should be paid to a subject which has heretofore been too much neglected in military education.

Mr. J. BRIDGES LEE:—In common with all the previous speakers, I have listened with the greatest pleasure, satisfaction, and admiration to this lecture. I feel confident that a lecture of this kind at this time cannot fail to do an immense amount of good. It is one of the most lamentable features in connection with this war that some people, at home at least, should believe that there has been perhaps a certain amount of unnecessary loss of life because we have no satisfactory maps of our own territory. I thoroughly agree with the lecturer in all that he says about the extreme rapidity and excellence of the Indian work. No doubt Sir Thomas is probably the greatest, certainly one of the greatest, of living experts in the matter of rapid survey and accurate map-making; and there can be no doubt in the mind of anyone who has ever observed the work of a native topographer in India that the work is done in a very rapid, careful, and accurate manner. When one sees those Ordnance Survey maps for almost any part of India, one is surprised to find how few errors there are, and how remarkably accurate the map is with regard to everything that is mapped. But when this has been said, of course, it must always remain a fact that the most perfect map ever constructed must lack a certain number of details. It is impossible that any man can map all the features. He will map all the features which appear to him to be important, and an experienced topographer will probably select without much difficulty, and with very little doubt, those particular features which are generally of the greatest importance, but it is impossible that he can exhaust them all. It is impossible for him to foresee what particular little pieces of information it might be desirable to have which may be missing from the map. Whenever anything is missing by the methods which are at present ordinarily used, it is always necessary to send somebody off to the spot to fill in the deficiency. It is not always possible, however, to send people there just at the time the information is required; certainly in time of war that cannot be done. When the enemy are occupying a considerable part of the country you can only make use of such maps as you have got of that part of the country or anything you can see from points of vantage you are able to reach. I make these remarks with the object of leading up to what I have to say with reference to other means which can

be used besides the plane-table. As is noted at the commencement of this paper, the plane-table had a very uphill battle before it came to be recognised by English surveyors as *the* topographical instrument *par excellence*. Many methods in other matters have been a very long time before they have been able to force themselves to the front and obtain recognition. The subtense method, for example, for measuring distances is very generally used now, but met with a great deal of opposition before it came to be at all generally used among our surveyors. In India nearly all the work has been done for a long time with a plane-table, based, of course, upon triangulation, and no doubt if we could get these plane-table topographers to go to Africa they would be able to do equally good work to the work they have been doing in India. But there is another large portion of British territory in which a great deal of excellent survey work has been done of recent years, namely, Canada. Very large tracts of Canada in the North-West District, through the Rocky Mountains, the whole of the Yukon District, the borderland of Alaska, have been surveyed, and, I believe, almost entirely by the aid of photography. The Surveyor-General, before adopting photographic methods, carefully considered other methods, which were tried. He had carefully weighed the whole matter, and tried numerous experiments, and he found the photographic method in some of those districts enabled him to survey the country with much greater rapidity and economy; and I believe it is generally admitted that the maps which he has made are not, at all events, deficient in accuracy. What I rather wish to suggest by way of commentary upon the lecture is, that when we are going to work in a new region like Africa, where almost new maps would have to be made, we ought to avail ourselves of all means which are certainly sound and good means of working, and, besides inviting aid from India, it would be good policy and facilitate the manufacture of these maps, if we were to invoke aid also from Canada. No doubt, at the present moment, there are in Canada a number of highly intelligent trained surveyors who have done an enormous amount of work in the way of mapping land from photographs. Supposing the country was surveyed primarily with a plane-table, as in India, under all circumstances it would be advisable to have a sort of collateral photographic survey, if it were only for the purpose of collecting a complete record series of photographs of the country. A map by itself never can give to a general the complete information he wants; a map is a projection on a plane, and will give distances from point to point along that plane, and if the contour lines are filled in accurately, then, with a fair amount of computation and measurement, you may, perhaps, be able to make out how much up and down there would be, and what the distances would practically work out at. But if you have photographs which give the elevation and the aspect of the country over which you are passing, if the photographs are survey photographs, not ordinary photographs which are incapable of interpretation, but survey photographs made in such a way that they can be interpreted with certainty, and if you know exactly the places where they were taken, they would convey an immense amount of additional information supplementing the information which you obtain from the map. I am not wishing to make this an occasion for giving an address on the methods of photographic surveying—it is a big subject—but to suggest, for the consideration of Colonel Holdich and all who may be interested, that we ought, considering the importance of the subject, and how absolutely necessary it is that we should have good maps, how much depends upon it, and how little by comparison is the cost of the map by the side of the lives of the people and the loss of material, to avail ourselves of all means which are known and have been proved to be efficient. We ought not to drill all our English surveyors in one school, and one school only. India is the best school; we have had the best survey officers from India; we have had much the best topographical work done in India; but still it is not the only school. Canada is another, and it may be hoped that one of these days we may have a good school in England. We might found a school in England at least for the interpretation of photographs. And supposing at this present moment we had in our

possession complete sets of survey photographs taken from known stations in South Africa—photographs taken under certain prescribed conditions which it is not necessary to enter into details about now, it would be possible, in an incredibly short space of time, to plot the whole of that country, and at any time when anything was found to be missing from the maps, most of those details could be filled in as required, without any necessity for revisiting the ground.

Colonel Sir T. H. HOLDICH :—I need not reply very much to the gentlemen who have so kindly taken part in the discussion, but I can hardly agree with Major Crook in his very strong criticisms of the Ordnance Survey Maps. I think we should remember that they are made for a special purpose, and that they meet that purpose fairly well. That purpose is not comprised entirely in the matter of military manœuvres. As a matter of fact, an ideal military map of England would, perhaps, be a little more useful to our enemies than it would be to ourselves ; so that we need not deplore its absence if, as Major Crook thinks, such a thing does not exist. From what Mr. Woolley has said about the surveys in the Orange Free State, a large amount of what would be called in India revenue surveys have been made ; but in order to turn them into useful topographical maps it would be necessary to compile them with very great care on some comprehensive scheme of triangulation. I did not gather from Mr. Woolley that such triangulation has been carried out over the country to enable this to be done. Mere cadastral surveys are not sufficient to furnish what I understand by a general topographical map which would be useful for military purposes. As regards the use of the prismatic compass, I purposely did not enter into details of the instruments that are used in making maps in India ; but I may say that we do make use of the prismatic compass pretty largely in circumstances in which the plane-table cannot very well be used. Mr. Bridges Lee is an authority on the subject of photo-surveying. I take great interest in the subject myself, because I believe there is a great future before it. The difficulties at the present time I consider to be more or less connected with technical details, and I think that no doubt they will be overcome, and I expect to see photographic surveying very largely developed in future. He will be pleased to learn, perhaps, that of the officers who have gone out to South Africa for the purpose of making surveys, one is a Canadian, an officer of engineers who has had the whole of his training in Canada.

The CHAIRMAN (General Sir H. W. Norman) :—We have been very much interested both in the lecture and the discussion, and I cannot but think that during the course of the reading of the paper our thoughts were very much directed to the disasters, as they may be called, which we think have arisen from the absence of good maps in Natal. When we consider, as the lecturer has told us, how very easily and quickly surveys can be made for military purposes, even in a very difficult country, and how very little they need cost, it seems marvellous that we had no proper maps of Natal, as far as I know. We have seen lots of maps in the newspapers, but they seemed to alter from day to day, as I do not think the country has altered ! Who is responsible for this lack of maps ? It is not our business to inquire, and if we did we should not be able to find out. The present system of military administration is so extraordinary that we might go backwards and forwards from pillar to post, from that wonderful Defence Committee to the Secretary of State for War, or the committee sitting at the War Office, or the Colonial Governor, or the Colonial Secretary of State, or the Treasury, and we should never find who is the person responsible for it. But I do trust that, after the terrible example we have had of neglect on the part of some department or departments, we shall take warning, and in future have military maps—certainly in a country like Natal, that we have occupied for some fifty odd years, and where, during the last few years, we have anticipated war. Certainly there was time to make a survey. I will now ask you, ladies and gentlemen, to join me in thanking very heartily Sir Thomas Holdich for his admirable paper.