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the author of both maps, it is very hard to understand why he should have made such capricious alterations. Again, the accuracy with which Ricci delineates Japan forbids us to suppose that he could have produced the Ambrosiana map later than 1602. But it seems equally improbable that, after making New Guinea an island and deleting the river Orases in South America, he should have reintroduced these errors in the third edition of his World Map. I am forced to the conclusion, then, that the Ambrosiana Map was not the work of Ricci at all.

NOTE BY MR. HEAWOOD.—The above divergences between the *Ambrosiana* and R.G.S. maps are certainly interesting, but are they not after all just what we should expect to find, even if the former were Ricci's work, in whole or in part? Dr. Giles has made it clear to what an extent Plancius' great map of 1592 was followed for Ricci's *later* editions (including our own map), but it was not in existence when the first edition appeared, and could hardly have been in Ricci's hands for some time (possibly several years) after its publication. No map made by him about 1592 could possibly show the features of the 1602 map due to Plancius. As Dr. Giles has shown, Ricci "was not thoroughly conversant with the Chinese language" when he began making maps, and had to trust to an interpreter for the translations which, as he says, "could not be free from mistakes," so that differences of transliteration between earlier and later maps need surely cause no surprise. With the data then existing, the less correct representation of New Guinea in 1602 would be rather an evidence of up-to-dateness than of inferiority in the 1602 map. Both versions depended merely on guesswork on the part of the European map-makers, and it was precisely Plancius who held the view (as against the representation of Mercator and Ortelius) that New Guinea was probably connected with the southern mainland; so that a map based on his would be bound to show such a connection. Ricci was in fact, in all his maps, mainly following what seemed to him the best authority for the time being. Thus in omitting the Orases river in about 1592 he would only have been following Ortelius, whose atlas we know to have been in the possession of the Fathers.

GERMAN WAR MAPS AND SURVEY

Arthur R. Hinks, M.A., F.R.S., Sec. R.G.S.

THE last four years have seen great progress in the art of map-production for war and in the application of survey to the improvement of gunnery. On the side of the Allies several quite new and most interesting methods have been brought to high perfection; but it has been forbidden to discuss at our meetings or deal in the *Journal* with mapping from air-photographs, sound-ranging or flash-spotting: three developments that have contributed much to the success that we have won, and deserve a high place in the scientific history of the war.

During a recent visit to France with the Chief of the Geographical Section, I was allowed by the kindness of the General Staff to study the British methods and to compare them with the German, as revealed in captured material; and though it is still impossible to say anything of British methods, I am allowed to put together the following notes on the performance of our enemy after four years of war.

Before the war the Germans had, in popular estimation, a high repute for map-making, which was partly deserved, owing to the admitted superiority of their two great atlases—those of Stieler and Andree—though their official topographical maps were no more than mediocre, and their maps in books and in journals such as Petermann were nothing to boast of. Nevertheless they were a scientific, industrious, and resourceful people, especially concerned in all the arts of war, and we expected that when we came to capture German maps and survey documents we should find both interest and instruction. But in this we have been disappointed; the enemy has shown little enterprise or originality; and a description of survey methods for modern warfare, limited to their development by the other side, will fall far short of what we may hope to publish soon, when the secrets of our own armies may be revealed.

The French military map was the celebrated *Carte de France* on the scale of 1/80,000, and on the projection of Bonne. It was a fine map in its time: but that time was before the present-day topographical map with its blue rivers, brown contours, green forests, red roads, grey and purple-hill-shading, and half a dozen more printings for colouring in layers. The French 1/80,000 was finely engraved, and printed in black only, with relief shown by hachures, but no contours. It was admittedly out of date, and was being replaced by the magnificent new map on the scale of 1/50,000, which at the outbreak of war was far from complete: indeed, non-existent for that north-eastern part of France which the neutrality of Belgium should have rendered secure against sudden attack.

Now it is interesting—indeed remarkable—that the Germans, though they had planned the outrage on Belgium, had not provided themselves with a better map of north-east France than a photographic reproduction of the French 1/80,000 in black. However carefully the enemy may have reconnoitred the ground, prepared concrete emplacement for heavy guns, taken note of the wells and the blacksmiths' shops and the capacity of the local bakeries, catalogued the private resources of the principal families, and marked down the loot in church or convent, they did not do what any one would have expected them to do first of all: they did not make a good coloured contoured map which, if not brought up to date by secret reconnaissance, should at any rate make the best, by the use of colour, of the existing French maps. They did nothing of the kind; or at least no specimen of their work has been discovered among the many thousands of maps, secret and otherwise, that have been captured. And as they were not specially careful in their use of confidential maps, declaring that the advantage to the troops in the front line of a good trench-map outweighs the risk of capture, it is improbable that we should not have found a single copy of an improved topographical map if one had existed. It would even seem that the enemy do not care for a good map when they see one. Tons of excellent British maps in the headquarters of one of our armies were abandoned perforce at Albert in the spring of this year, and

were salved on the re-occupation of the town in the early autumn. Several specimens from the pile of ruins that was once the hospital will be preserved in the museum of the Society to illustrate this curious trait of the enemy.

As they did not provide a really good map on a moderate scale, they could not be expected to foresee the urgent need for much larger-scale maps which became apparent to both armies as soon as the war of movement ceased and siege warfare in the trenches began. This need took both sides by surprise, and a desperate effort was required to provide for the mapping of the maze of trenches, dug-outs, craters, trench mortars, wire, light-railways, and dumps that replaced the almost obliterated original detail. More room was wanted to show dispositions and plans; and at first both sides enlarged the French 1/80,000—the Germans to 1/50,000—giving a coarse and ugly map which has survived with them to the summer of this year. They have given it brown contours, invented from the hachures of the original or copied from ours; have in some cases coloured the valley bottoms green, after the fashion of the *Thalsohlen* of the Austrian Staff maps; some sheets have been given a grey hill-shading that does little more than occupy the areas which are not green; but no sheets come up to the standard in style of even a moderately good modern topographical map.

The process of enlargement could not be carried very far, and some means had to be found of supplying the additional detail required on a scale of 1/25,000. For the area round French fortresses there were French *plans directeurs* on the scale 1/20,000, which must have fallen into enemy hands in the occupied territory, together with the manuscript plans of the French *cadastre* on the scale 1/2500 which were in the charge of the local authorities, and can hardly have escaped. Doubtless the Boche also obtained co-ordinates of the French triangulations of various dates, and perhaps found exercise for his ingenuity in piecing together the different sections of this work, which, it may be admitted, would present points of interest and difficulty when captured piecemeal, without benefit of the knowledge that resides in Paris. But without these advantages he would find it necessary to do a good deal of re-survey of detail, before his map would respond to the exacting requirements of the air-photographer, the sound-ranger, and the up-to-date artillerist. There is evidence that the enemy was slower than we were in coming to this conclusion, and also that his detail-surveyors did not appreciate work in "unhealthy" areas. But curiously enough, he did not appreciate our work either. When it fell into his hands by the accidents of war, did he think that the British were not clever enough to deceive him, or that they were too stupid to copy French maps correctly? In any event, he was slow to avail himself of opportunities that lay ready to his hand, and his own work in the forward areas was of little use to us when it fell into ours; though further back his surveyors had done better.

Air-photographs are now familiar enough, and there is no need to emphasize the perfection of their detail, the exquisite definition with which they show all trenches and military works, or the enormous help that they have been to both sides. There are aspects of air-photography that will give us topics of discussion at afternoon meetings in days to come: the best methods of eliminating an unintentional divergence of the camera from the vertical, or of utilizing pictures taken deliberately slanting to get a wider field of view: how to avoid distortion due to the travel of the lens during the passage of the focal-plane shutter; and the proper use of the stereoscope for contouring from pairs of air-photographs. Meanwhile we may say that the enemy have made pretty successful use of air-photography for trench-mapping, and their plans of the Allied trenches have even on occasion been useful to the owners, saving time for dealing with the enemy's rear organizations which would otherwise have had to be given to our own. Of the enemy methods of dealing with air-photographs I have come across no detailed description, and it will be interesting to see whether the resources of the firm of Zeiss and the eminent Dr. Pulfrich have produced an apparatus so geometrically sound and so simple to work as the one that I observed with pleasure in the cellar of a certain French chateau, the Field Survey Battalion Office of a British army.

The progress of shooting by the map, and the recondite methods of artillery-ranging and spotting that we shall presently mention, require a convenient method of map-reference by co-ordinates which—familiar though it may be in the cadastral drawing office—is foreign to the experience of most map-users, who have been content in the past with latitude and longitude for map-referencing. For the calculation of distance and azimuth these are inconvenient, nor are they very well adapted for the simpler purpose of defining a point on a particular rectangular sheet, since they would have to be expressed in minutes and seconds (failing a general adoption of the centesimal system) and the variable value of a degree of longitude would cause trouble. Both sides arrived very soon at the decision to employ a system of rectangular co-ordinates, but neither the British nor the Boche found it convenient to use the co-ordinates based on Paris, which were given ready to use on the corners of each sheet of the French 1/80,000 map. Doubtless the German was amused at the conservative Briton, who at first preferred to use a "grid" of squares 1000 yards a side, with a resulting overlap top and bottom of each sheet of his topographical map. On our side we smiled when we began to capture Boche sheets bearing three different grids, with a pronounced misfit, on the same sheet, and thus learned that the enemy, by want of intelligent prevision, had started three separate systems with origins at Lille, Rheims, and Paris respectively, from which complication he was never to escape. The calculation of bearing for laying a gun, when the target is on the Paris grid, the gun on the Lille grid, and the nearest trigonometrical point on the Rheims grid, must have presented an elegant

problem, useful in examinations at the artillery school of Wahn, but distracting to a battery-commander in war of movement. It will be hard to estimate how much damage was done to the cause of scientific gunnery in the German army by their failure to foresee the need of one uniform grid covering the whole field of operations, and capable of indefinite extension.

One curious result of the war will be the impetus that it has given to the study of certain types of map projections. A rectangular grid will doubtless be an integral part of any future scheme for a series of topographical maps on a fairly large scale, as it was for the Carte de France, though it is doubtful whether in peace many users of that map gave much thought to the co-ordinates in metres inscribed at each corner of the sheet. In warfare they have taken on great importance, and there has been much discussion of the merits—or perhaps of the demerits—of the projection of Bonne for large-scale military maps. The obliquity of the meridians to the parallels is scarcely apparent to the eye on a map of eastern France, though the central meridian of the projection is that of Paris; but to the surveyor who has to intercalate further triangulation —a necessity hardly contemplated by the original makers of the map— this obliquity is a serious nuisance in calculation; and with increasing refinement in the use of survey for artillery it is not quite unimportant to the gunner. The enemy appear to have made their three grids on the polyhedric projection, following the routine of the topographical services. It is a projection without much interest or merit, suitable enough perhaps for those who are content with several different grids, but incapable of that elasticity desirable in warfare that was not going to remain for ever in France. If the shade of a certain eminent geometer can bring himself to revisit the country of his birth, he will feel himself little honoured there, but better appreciated by the Allies, as will eventually appear.

The continuous grid involves a single projection for the whole map series, as in the French or our own rectangular sheets: not an independent plotting of each sheet, bounded by meridians and parallels, as were the German topographical series on 1/200,000 and 1/300,000, that from the point of view of geographical co-ordinates had considerable advantages. There are interesting questions that may not be discussed now, but will at some future time deserve the attention of geographers, for they are not at present either adequately treated in the text-books, or consistently developed in practice.

The most elegant development of all scientific warfare is in sound-ranging. When a long-range gun could lie hidden by day, and fire only at night or when no aeroplanes were about, it became very necessary to devise some method of determining its position, for counter-battery work. It will never be known how many people thought of the elementary principle of sound-ranging, for it is obvious enough that if one can measure the time-interval between the arrival of the report at two stations,

the gun must lie on a hyperbola whose foci are the two stations, and whose dimensions are derived very simply from the velocity of sound and the time-interval. We do not at present know whether the enemy thought of this independently, or whether he heard somehow that it was practised on the other side. So far as we know his method of putting the idea into practice, with stop-watches, was but a poor thing, and little credit to him as a scientific soldier. He was conscious of his deficiencies, for in captured orders we read:

> According to a captured English document the English have a well-developed system of sound-ranging which in theory corresponds to our own. Precautions are accordingly to be taken to camouflage the sound: *e.g.* registration when the wind is contrary, and when there is considerable artillery activity, many batteries firing at the same time, simultaneous firing from false positions, etc. The English have an objective method (self-recording apparatus). It is important to capture such an apparatus. The same holds good on the French front.
>
> (Signed) LUDENDORFF.

There is every reason to believe that Ludendorff was disappointed in his hope of capturing the alleged apparatus, but within the last few months the enemy had evolved something of the kind, which it will be interesting to compare with ours. As to the precautions, the enemy will be disgusted to learn that if you fire six guns at once it *may be* that the positions of six guns are determined at once, when you have really good apparatus and skilled operators.

The enemy got his sound-ranging going about two years too late, having until near the end only the elementary method of stop-watches. Sometimes he timed the interval between flash and report, but more generally the process was as follows: Four posts were established over a total base of 10 to 15 kilometres, with a forward observation post. All were connected by telephone. When the forward observer heard a gun he sent a telephone signal (buzz) on which the watch observers started their watches, stopping them at the sound of the report. Alternatively they started them when they heard a report, and stopped them at a later signal, reporting the times to group headquarters. From examination of captured posts and documents it is believed that this was the sole method in general use, though there is mention of an automatic recorder on trial in December 1917 at the artillery school of Wahn, and a prisoner has stated later that an apparatus with microphones and string galvanometer had actually been brought into use. It was at any rate not common, stop-watches remaining the usual and thoroughly unsatisfactory method. The quantities to be measured are small, generally only two or three seconds, which must be measured to a hundredth. Those familiar with personal equation in time observation will see that this method is essentially crude and inaccurate. Its authors did not profess that it would succeed unless half a dozen rounds from the same gun could be observed, and even then the

error of the resulting gun position was found to be several hundred yards. A sound-ranging group obtained on the average less than five guns a day, with this large error; and altogether the Boche *Schallmesstrupp*, or sound-ranging section, was disappointing.

At flash-spotting—another recent development—he was better. A *Lichtmesstrupp* was formed from the personnel of survey parties for the siege of Antwerp, and since that time their organisation had been greatly extended. The principles were simple. Observers in three or more stations of known position were provided wiih binocular telescopes having horizontal circles which could be set to zero at true or grid north. The observers measured the bearings of gun flashes and transmitted them by telephone to the group headquarters, where the bearings were plotted, and the guns fixed by the intersection of three lines at least. The only real difficulty was to secure that all observers were watching the same gun. Observers were all connected by telephone, and one was appointed leader in each area, who by telephonic instruction and signals to the others managed to get a second observer making his readings at the same moment, and therefore presumably on the same gun. The intersection of two rays gave a preliminary position which directed the other observers on the gun, and the position was thus verified.

Both sound-ranging and flash-spotting require the maintenance of a complex telephone system, which is far from easy, especially when tanks are about. The German, in his official reports, was eloquent on the delay due to the destruction of his connections by enemy fire.

Sound-ranging and flash-spotting give the positions of many guns, which are reported to the counter-battery officer as co-ordinates on the map. To calculate their bearing and range he must know the co-ordinates of his own guns, and the true or grid bearing of some point of reference from which he can lay his guns. All this requires a system of battery survey which, though fairly simple, is more complicated than the artillery officer was accustomed to, and which, to judge by the German instructions, he had successfully resisted, throwing the duty on a special survey party. Have we believed that the German artillerist was stuffed with mathematics, and trained to the last gasp in the technique of his profession, past, present, and future, we may read with comfort the lecture delivered by Lieutenant Raths to the artillery officers of Von Linsingen's army, which was reprinted for general instruction, captured on the western front, and from which I am allowed to make the following extracts:

As so often happens in peace-time, it was only those few who were specially interested in the technical details who knew of the fundamental training manual which still remains a sound basis for all the important features of war survey. For the rest of the army this subject remained virgin soil. Particularly was this so in the field artillery, to which a *rôle* had been assigned differing essentially in principle from that of the heavy artillery. Battery boards, for example, had been foreseen for the heavy and garrison artillery, but not for

the field artillery ; map shooting was not considered to lie within the field artillery tactics. . . .

The man who thinks of the Survey as a mere revision of maps, as a drawing office, or even as a mere printing establishment, has no understanding of what the work really means. The cardinal factor of the work of a survey unit is to fix points for the artillery. . . . The one all-important end in view is not mere map compilation, nor interesting theoretical questions of a quasi-military character, but to shoot and to hit. To this end the survey section is a useful and indeed indispensable ally. Terms such as triangulation and trigonometry have for many years had a peculiarly indelicate sound to the ordinary human ear. Glad indeed was the soldier to think that he had nothing more to do with them. Our old hearty military methods must however now be complicated by sine and co-ordinate, by resection, hyperbola, and the rest of the tribe. Pressing necessity compelled the use of any technical means to keep pace with our enemy. One need only mention the French, amongst whom the simple gunner knows enough of map-shooting and intersection to compel our amazement and admiration.

The lecture as a whole is a good survey propaganda, such as might have been delivered by survey officers to their fellow-officers of artillery on either side. Shooting by the map was a new idea received with distrust, that was to some extent justified by the badness of their maps. We read, for example, in the orders for the 14th Army Corps, dated so recently as 7 June 1918 :

There is a general impression that map-shooting from surveyed battery positions on hostile batteries without previous registration is worthless. This impression is based on the errors which are evident in the maps. The conclusion however is not correct. Since survey of battery positions and of survey posts is done from a system of trigonometrically fixed points, it may be taken as errorless. It is quite possible that the position of the battery with reference to the detail and contours of the map may be seen to be bad. This is the fault of the map. For example, a battery which is really in a valley or on the east side of a road may appear as surveyed to be on the forward slope, or on the west side of a road. In the trigonometrical system it is however accurate.

It is hardly possible that such an order could have been written on our side so late as June last.

Battery boards, says Lieut. Raths, had been foreseen for the heavy and siege artillery, and in this the enemy were ahead of us. The artillery board, as it is called by us, is a map mounted so that it is true to scale : that is to say, a map cut up into pieces which are stuck down on a carefully constructed graticule drawn on a metal or three-ply wood table, to eliminate the distortion of the paper. Unless the map is mounted in this way it is impossible to measure distances and bearings with the accuracy needed in modern long-range artillery fire. In map-shooting an initial range and bearing, for the battery zero line, may be, and should be, calculated from the co-ordinates of the gun and the target, measured upon the grid of the map ; but in rapid change from one target to another

this is not convenient, especially to those for whom trigonometry has an indelicate sound. The Germans were especially fond of graphical methods, and did little calculation in the field, even in their survey, so they very naturally developed the artillery board, of which two magnificent specimens are on their way to our museum. The later types had paper graduated arcs pasted on them, which if checked by measurements are very serviceable; but their maps were almost uniformly bad.

A very curious feature of German artillery methods is their division of the circle. The British gunner measures his deflections in minutes of arc, which is convenient in that his instruments are graduated in the same way that all ordinary instruments for measuring angles are graduated, in degrees and minutes, and the ordinary trigonometrical tables are used; but to some extent inconvenient in that a deflection of so many minutes is not very simply translated into so many yards right or left at a given range, since the awkward number 3438 appears as a divisor. Foreign artillerists in general like to work with a unit which is the thousandth of the unit of circular measure, so that a deflection of one unit puts the burst one metre right or left at a range of 1000 metres, and the necessary corrections are easily calculated. But this requires that the circle shall be divided into 6283 parts, which is very awkward for the dividing engines. As a compromise it is common to use a circle divided into 6400 parts, or actually into 640 parts, with subdivision by vernier or micrometer head. The German field artillery used this division, and it was the common unit in the artillery "director." But the "foot artillery" and the heavy artillery used the very curious division of 1/576 of the circle, or one-sixteenth of ten degrees; and what is still more curious, this unit was used by all German guns for their elevation and range tables. Thus we have the strange phenomenon of different units of angle in use by different branches of the same arm for the measure of deflection, but the same, and that the apparently meaningless unit, used for elevations.

In studying the captured German maps we have therefore to remember that the *Fussa-Teilstreich* is 1/5760 of the circumference, and the *Felda-Teilstreich* is 1/6400 of the circumference. Both units are found on the little diagrams that give the variation of true north and magnetic north from the north of the grid. In the course of the war the former unit was abolished.

The real interest of this somewhat technical matter is in its bearing on the question, how far the German army was scientifically organized. We have seen that their mapping organization was not by any means up to date. The duality of units in measure of angle shows that the artillery were in this important respect still more conservative. It will be interesting to learn some day the origin of this singular unit of one-sixteenth of ten degrees, and why clinometers were divided in the still more singular unit of one-sixteenth of two and a half degrees. Maybe it was as old as the meridian of Ferro, from which German longitudes are still reckoned

in name, though, as is well known, the inability of mediæval geographers to fix this origin of longitudes was evaded by the simple device of assuming Paris to be 20 degrees east; so that official German longitudes are longitudes east of Paris plus 20 degrees.

The specimens of captured German maps now added to the Society's collection by the kindness of Maps G.H.Q. are briefly described in the notes which follow. One gets the impression from them that the Bavarians and Saxons were better cartographers than the Prussians; but that none of them did much more than enlarge the French maps until the summer of 1918, when there was a sudden output of rather coarse but clear and well-drawn maps, quite a number of them dated as valid from July 22—a date whose significance, whatever it may have been, was anticipated by Marshal Foch.

1. Unpublished sheet of the regular German series 1/300,000. Taken from French 1/200,000. No special detail except fortifications of Paris. Cartographical Section of the R. Prussian Land Survey, 1913.

2. Flying Map for Field use, 1/200,000: evidently based on the Topograph. Spezial Karte von Mittel-Europa, but sheet lines different. Railways, roads, and woods roughly overprinted in colours. Fortified area red. Compiled in the Cartographical Section of the Representative General Staff of the Army, 1916. Printed 1917.

3. Sheet 3 of a largely used and unofficial map on curious scale 1/105,000, roughly drawn from French 1/100,000. Fortifications exaggerated. Approximate front at unspecified date.

4. Sheet 1 of same series from Belgian 1/40,000. Light railways and tramways indistinguishable from standard gauge railways.

5. Belgium 1/100,000, 1916. Topography in general from Belgian 1/100,000, but many alterations and additions. Spelling of names is altered throughout. Cartographic Section, Representative General Staff of the Army, 1916.

6. Quarter-sheet French 1/80,000, with number of inhabitants added, and scales of geographical miles (1 mile = 7·42 km.) and paces (5000 Schritte = 4 km.) No new work. French centesimal graticule remains, but co-ordinates cleared from corners.

7. Photographic reproduction of parts of four sheets French 1/80,000, with additions and corrections from Belgian 1/40,000 in N.E. corner, and new railways and sidings added. No co-ordinates or grid. Bavarian Survey Section, No. 9. 1 February 1918.

8. French 1/80,000 enlarged to 1/50,000. No additional detail. Co-ordinates cleared from corners. No grid.

9. No. 8 redrawn, but no sign of new work. Contours in parts agree nearly with original British contours sketched from the French hachures, but differ completely in other parts. 10 seems to be intermediate between 8 and 9. Army Printing Press of the Stoverm, A.O.K. 2.

10. Combined sheet 1/50,000. No date nor authorities. Does not agree closely with 13 and 14. Sheet has both graticule and parts of two grids. Compiled by Headquarters Survey Service, Second Army, and printed by Bavarian Survey Section, No. 9.

11. French 1/80,000 enlarged by photography to 1/50,000. Contours in red evidently copied from the British edition of French 1/80,000 issued to original Expeditionary Force, 1914. No additions to original detail. Valley bottoms

coloured green: frequently disagree with contours. Sheet made up by joining French sheets. No co-ordinates or grid. Graticule not figured. Cartographical Section, Royal Prussian Survey, 1918.

12. French 1/80,000 redrawn on 1/50,000 with addition of valley bottoms green, and very poor hill-shading. Shows British rear organization: camps, billets, field railways, dumps, landing ground, hospitals, mapped from air photographs and reports. Cartographical Section, Royal Prussian Land Survey, 1918.

13. Weekly Artillery Map, No. 8, 1/25,000. Same sheet as No. 14, but drawn from different material and by different section.

14. Weekly Artillery Map, No. 12, 1/25,000. Diagram of authorities: parts still based on French 1/80,000, though there must have been captured British maps available. 22 July 1918. Stoverm A.O.K. 2. (Saxon.)

15. Section of 1/25,000 map for Report. (N.E. corner of 13 and 14, but not same drawing. Compiled and printed by 12th Survey Section (1 Saxons). Note junction of two grids.

16. Sheet of 1/25,000, North-West France covering middle-west portion of 18, but different drawing, apparently earlier date, as professedly enlarged from French 1/80,000. Great similarity of contours suggests that the captured material used in 18 was not the new British survey. H.Q. Survey Service, Second Army. No date.

17. Overlaps S.W. corner of 18, but different drawing of detail though essentially the same. Note in corner, "The drawing is not very accurate. Especially there is no reliance on contours which are developed from hachures." 3 June 1918. Overprinted with arcs and ranges to serve as Artillery Board.

18. Combined sheet 1/25,000, Corbie-Bray. Overlaps and is same as 13 and 14, but more elaborately overprinted with British organization. Some new survey in middle.

19. Organization of Ypres Salient 5 April 1918, 1/20,000. Much detail not on 1/20,000 Belgium. Many villages in devastated area have been taken off plate.

20. British rear organization. Scale 1/10,000. "New compilation based on trigonometrical and topographical surveys," *i.e.* really copied from Belgian 1/20,000. Note confusing numbering of grid. 13 January 1918. Revised to 22 March 1918. Survey Section 24. A.O.K. 4.

21. Topography is photographic enlargement to 1/10,000 of part of 20, but overprinting has been redrawn and does not agree precisely though of same date. (Saxon.)

22. Enlargement of 1/20,000 by photography to 1/10,000. Three grids Belgian, Paris, and Lille on same half-sheet.

23. Scale 1/5000 on French front east of Rheims; French detail and rear organization from air photographs. Note that the grid is 500 metres, and the numbering overprinted is confusing.

24. Section of 1/25,000 map for Air and Troop reports with instruction on back.

25. Another sketch-map for reports, reproduced by some multiplying process, such as hektograph.

26. Panorama printed in collotype with map references and section of 1/25,000 map. Very useful and practical.