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METHODS AND PROCESSES OF THE ORDNANCE SURVEY.

(Read at a Meeting of the Society, Edinburgh, 19th March 1891.)

BY COLONEL SIR CHARLES WILSON, K.C.B., K.C.M.G., F.R.S.,

Director-General of the Ordnance Survey.

THE Cadastral, or, to use the more familiar name, the Ordnance Survey of the United Kingdom, is one of the most remarkable and complete works of the kind that has ever been undertaken; and it will always be regarded as one of the most valuable acts of practical government that has been carried out in this country. At the memorable Paris Exhibition of 1867 French experts classed the Cadastral Survey as "a work without precedent," and one that ought "to serve as a model for all civilised countries;" the British publication processes have been largely adopted by India, the Colonies, and foreign States; and a very high tribute was paid to the scientific accuracy of the Survey when the countries of the world intrusted the comparison of their national standards to Col. A. R. Clarke, C.B., F.R.S., one of its most distinguished officers.

The Survey had its origin in the military necessities of the troops quartered in the Highlands during the troubled period that followed Culloden. Roads had to be made for the passage of men and supplies; and, to facilitate their construction, General Watson, an Engineer officer then serving as D.Q.M.G. on the staff of the Duke of Cumberland, conceived the idea of making a topographical map of the Highlands. In this work he was assisted by William Roy, an Engineer officer of high scientific attainments, who measured the first base-line on Hounslow Heath, and gave the National Survey that military character which it has since maintained.

In 1791, just a century ago, a trigonometrical survey of the country was ordered for the purpose of producing a military map; and in 1797 it was decided to publish a general map of the kingdom, founded upon a minute survey. This map was on a scale of one inch to a mile, and the first sheet was published on the 1st January 1801.

In 1824 this survey was partially suspended, in order that Ireland might be surveyed on a scale of six inches to a mile, for a general land valuation. In 1840, the survey of Ireland being almost completed, and the 6-inch plans having proved to be of great practical value, H.M. Government decided to continue the survey of Great Britain on the 6-inch scale instead of on the 1-inch. This order continued in force until 1851, when there commenced a Parliamentary struggle, which has not inaptly been called the "Battle of the Scales." The battle lasted nearly twelve years, during which period one Royal Commission and three Select Committees of the House of Commons reported their views upon the scale most suitable for a national map. The 6-inch scale was stopped, and the 1-inch reverted to; then the 6-inch scale was ordered again. For fifteen months the Director-General had no orders as to

scale; in 1857 Parliament sanctioned the adoption of the 25-inch scale, and in the next year refused the money to carry it out. The Survey Department was disorganised, the public were dissatisfied, and a sum of £30,000 was absolutely wasted during the progress of the battle.

Finally, in 1863, it was definitely laid down that the undermentioned plans and maps were to be published:—

1. Town plans, on a scale of $\frac{1}{500}$, or 126·72 inches to a mile (commonly called the 10-foot scale), of all towns with more than 4000 inhabitants. On this scale 1 inch on the plan represents 500 inches on the ground.

2. Parish plans, on a scale of $\frac{1}{2500}$, or 25·344 inches to a mile (the 25-inch scale) of the cultivated ground in all counties. On the plans of this, the true Cadastral Survey, a square inch represents very nearly an acre, and the area of every parcel of land is computed and published either separately or on the plan itself.

3. County maps, on a scale of $\frac{1}{10560}$, or 6 inches to a mile; which show the form of the ground by contour lines at regular vertical intervals.

4. A topographical map, on a scale of $\frac{1}{63360}$, or 1 inch to a mile, in two forms: one in outline, with contours only; the other with the hill features.

5. Map of the United Kingdom, on the scale of 4 miles to the inch.

6. Map of the United Kingdom, on the scale of 10 miles to the inch.

Since 1863 the only changes of consequence that have taken place are:—The authorisation, in 1872, of a new 1-inch map of England and Wales, based upon the Cadastral Survey; the issue of authority to revise the maps of Great Britain in 1886; and the order, issued in 1887, to publish Ireland on the $\frac{1}{2500}$ scale. I may add here that we owe the Cadastral Survey very largely to the action taken by the Scottish M.P.'s in the Parliamentary Committees.

I do not propose, on the present occasion, to describe the measurement of the base-lines, and the operations connected with the principal triangulation and the levelling of the country. The trigonometrical operations involved an amount of privation and exposure which can hardly be appreciated by those who did not take part in them. Toilsome marches each day whilst station-hunting in the Highlands, and in the wilder districts of Ireland; weary watchings, sometimes for weeks, on the top of a high steeple or lofty mountain, waiting for the signal-flash from some far-distant station; complete isolation for months in a solitary camp on some rugged peak; snow-storms and furious gales, during which tents were blown down, and the safety of the great instruments endangered. Such were some of the experiences of officers and men. The rough life was not, however, without its charms; no one can read Drummond's graphic letters to his mother without feeling how much there was of interest, adventure, and romance in the work; and how well calculated it was to bring out the best qualities of the men employed upon it. The minute and watchful care bestowed upon the measurement of the bases and of the angles of the triangulation were well rewarded.

When 500 feet of the Irish base were re-measured, in presence of Sir John Herschel and Mr. Babbage, the difference between the old and the new measures was only one-third of the finest dot that could be made with the point of a needle. And when the base on Salisbury Plain was completed from the Loch Foyle base, through a network of triangles covering an intervening space of 360 miles, the computed length was found to differ from the measured length, of nearly 7 miles, by only 5 inches, a result which has well been called a triumph of geodesy. I regret to say that the scientific work of the Survey, which was at one time equal if not superior to that of Continental countries, has, in consequence of the pressure to complete the cadastral map, been for some years in abeyance. Nearly all other countries have re-measured the angles of their principal triangulation, and re-levelled their main lines of levels with the more perfect instruments of the present day. Great Britain should do the same. It is most desirable, in the interests of science, that the angles of the principal triangulation should be re-measured, and the main lines of levels re-levelled with improved instruments; that there should be new tidal observations, with the best self-registering instruments; that pendulums should be swung at selected stations; and that the differences of longitude between certain points should be determined with greater accuracy than they are at present. I hope that the scientific work may some day be resumed, but, as it is not necessary for the revision of the plans, I fear there will be much difficulty in obtaining the requisite money.

The 25-inch or Cadastral Survey of this country differs from similar surveys in foreign States, in that it is directly based upon the triangulation. The chain-surveyors work in the tertiary triangles, whose sides average $1\frac{1}{2}$ miles in length, and all details are fixed by rigid measurement with the chain; the limit of error allowed is two links in 1000, and all errors of survey in a triangle are strictly confined to that triangle. Errors cannot be entirely excluded, but, on the whole, the British Survey may claim to be the most mathematically accurate in Europe. All maps on smaller scales are reduced from the 25-inch map, which is called the "parent" map.

The field work of the Survey consists, at present, of the re-survey of Yorkshire, Lancashire, and Ireland, on the 25-inch scale, they having been originally surveyed on the 6-inch scale, only; the revision and re-survey of the towns in Ireland, and the two English counties; and the survey of new London. The next work to be taken up is the re-survey, on the 25-inch scale, of the six Scotch counties which were originally surveyed on the 6-inch scale, and this will be commenced during the course of the present year.

In carrying out the re-survey, the original 6-inch survey is largely utilised; the detail is plotted from the old field-books, and tracings of the outline are then made on tracing paper of a convenient size for examination in the field. On these traces buildings are outlined in red, streams and water in blue, other detail in black. The "Examiners" supply all new detail on the tracings, and obliterate that which is obsolete; they define roads as main, parish, or occupation; indicate

whether buildings are of masonry, iron, or wood, supply names, and test generally the correctness of the boundaries. A final examiner goes over the work of each party of examiners, and is responsible for its accuracy.

The trace supplied to the examiners is returned to the division office when completed; a draughtsman then transfers all the corrections to the plotted plan, and afterwards pens in all outline, colours the buildings and water, etc. All ornament, trees, furze, shingle, and rough pasture are stamped on the plans, and all names are typed. As the plans are reproduced by photography, the lines are made as black and sharp as possible. After the drawn plan has been thoroughly scrutinised by a "plan examiner," it is examined on the ground by the division officer.

The area of each enclosure is then computed and written down in a book of reference for examination at head-quarters. Each enclosure has a separate number, the numbers running consecutively through the parish. Up to this stage eight persons, who form mutual checks on each other, are employed on the production of one plan.

The plans are now sent to the levelling division for the insertion of bench marks and levels; and they are afterwards forwarded to head-quarters, Southampton, where they undergo a thorough scrutiny as to execution, agreement with the traces and other documents, and general conformity to Survey usage. The areas of the parcels are again computed and tested, and the plans are then returned to the division officer, with a list of remarks which may have arisen during their examination. On the return of the plans from the division, with the remarks attended to, the acreages are stamped underneath the parcel numbers, and the work is then forwarded for publication.

There is a wide difference between the practice of this country, in regard to the publication of large-scale plans, and that of foreign countries. In the United Kingdom the town and cadastral plans are published and sold at prices which are intended to cover the cost of publication. In foreign countries the plans are, as a rule, kept in MS., and copies, either tracings or lithographs, are supplied at the cost of the applicant; they are only published when necessary for special purposes, or to meet some particular demand. The publication of the English plans was authorised under the expectation that they would be largely utilised for administrative purposes, and by owners and occupiers of land; and that there would be no difficulty in selling out an edition, and so recouping the cost of publication.

Owing chiefly to the policy that has been adopted with regard to the sale of the maps, and to the ignorance of their existence in country districts, this expectation has not been fulfilled. In some cases sheets have run to two and three editions, but in a very large number of instances only two or three impressions out of an edition have been sold. The labour entailed by the publication of these large-scale plans has been enormous, and very much beyond anything that the Survey departments of other countries have been called upon to undertake. Their production and publication have been the real work of the Ordnance Survey Department during the last thirty years, rather than the production of maps on smaller scales.

Up to 1853, all Ordnance Survey maps were engraved on copper; but, in 1854, lithography was adopted for the $\frac{1}{500}$ and $\frac{1}{2500}$ scales. This was soon displaced by zincography, which has in turn, since 1889, given place to photo-zincography. The art of printing a line-photograph in permanent ink from a zinc plate, or photo-zincography, was discovered in 1859, but excepting for the reproduction of national MS., no practical use was made of the discovery until 1881, when the process superseded engraving for the production of the 6-inch map. To obtain the full advantages of the process, the MS. $\frac{1}{2500}$ plans were drawn in a style suitable for reduction, *i.e.* the buildings were coloured yellow to reproduce black, and the names, ornament, numerals, etc., were exaggerated so that their reduction might be of the proper size. This arrangement had its disadvantages. The $\frac{1}{2500}$, or parent map, still continued to be published by zincography, and was really sacrificed to its offspring, the 6-inch map, which was published months in advance of its parent. It also ruined the drawing, which was formerly so much admired, for the draughtsmen, realising that their efforts were only directed to the preparation of a groundwork for a mechanically-reduced map, lost interest in their work. In Ireland, however, where photo-zincography has never been introduced, the MS. plans continued to be very beautiful works of art. Photo-zincography has now been adopted for the publication of all new plans on the $\frac{1}{500}$ and $\frac{1}{2500}$ scales, with the following advantages:—Fidelity of reproduction of the original; saving of cost in the case of close work; acceleration of publication; uniformity of execution; great improvement in the style of original drawing; and facility in revising town plans. The parent plan has also resumed its proper place in the publication in advance of the 6-inch map.

The photo-zinco process is so well known that I need not describe it here, except to point out the large scale upon which photo-copying is being carried out by the Ordnance Survey Department. The $\frac{1}{2500}$ plans are photographed their full size of 38·016 inches by 25·344 inches; and the glass plates measure 45" × 30", and weigh 33 lbs. The paper used for the photo-transfers is Evans' thin paper; and it might be thought that a system of photographic reproduction, based on a flimsy paper transfer, would introduce many elements of inaccuracy. In practice, however, the process is found to compare favourably, as regards accuracy, with zinc etching methods, and engraving on stone or copper. Impressions varying more than one-sixth per cent. from the true scale are now cancelled. This result is very largely due to the skill that has been acquired by the photographic and printing staff.

The following method has recently been adopted for producing the $\frac{1}{2500}$ plans of large towns from the $\frac{1}{500}$ plans:—A convenient number of $\frac{1}{500}$ plans are pinned together, and a negative of the reduction obtained in the usual way. From this negative a cyanotype print is obtained, the result being a pale blue image on a white ground. The necessary drawing is now proceeded with on the cyanotype, and, when complete, it is fixed in its proper position with the surrounding $\frac{1}{2500}$ detail, and then re-photographed for publication.

The maps are now printed by a specially designed steam zinc-plate

printing machine, which, when necessary, can print 900 impressions an hour.

THE 6-INCH SCALE.—Until 1881, the 6-inch map was engraved on copper, the reduced detail being obtained from the $\frac{1}{2500}$ map by photography. In 1881 it was decided to abandon engraving in favour of photo-zincography, and the practice was to pin four $\frac{1}{2500}$ sheets together with their proper margin, and reduce them at once to a quarter sheet.

The present system is to take a blue impression of each $\frac{1}{2500}$ sheet as it is being printed for publication, and upon this to pen in to scale all detail that is to appear on the 6-inch map, in black, whilst the names, ornament, trees, numerals, etc., are typed in an exaggerated style, so as to be of suitable size when reduced. All parcel and area numbers and unimportant detail are not penned in, and, being in blue, do not photograph. Four such plans, forming a 6-inch quarter sheet, are placed together and reduced at once by photography. The parks, mud, and sand are inserted in a tint by transfer from copper after the photo-transfer has been laid down on zinc.

The 6-inch quarter sheet was adopted partly for convenience, the size being much more handy than that of the full-sheet, and partly for acceleration of publication, for a quarter sheet can be published as soon as the four component $\frac{1}{2500}$ plans are received, without waiting for the other twelve.

It may be mentioned that, as an experiment, sixteen $\frac{1}{2500}$ plans were placed in position on a screen with the proper margins, and a full 6-inch sheet produced from them in one operation. There was a slight distortion towards the corners, but I believe this may eventually be overcome.

THE 1-INCH MAP.—The MS. map on the scale of 1 inch to a mile is produced from the 6-inch maps by the aid of photography. The 6-inch map is printed in light-blue ink, and the detail that is to appear on the 1-inch map is then penned in with black ink. By this means only the details in black appear on the reduced photograph which is used by the engraver. This reduction also gives the index map to the $\frac{1}{2500}$ sheets in a 6-inch sheet, which, by the use of stencil plates, we are able to sell coloured for 2d.

One of the most troublesome details we have to deal with in producing the 1-inch map is the selection of the names and artificial features that are to appear on the smaller scale. In the old 1-inch map this difficulty did not occur, for the survey was made on the 1-inch or 2-inch scale, and the surveyors only showed those features that could properly be represented on that scale. The old 1-inch was also a military map, and details not of military importance were omitted. The new 1-inch map is produced by a more or less mechanical reduction from the 25-inch plans, by men who have no personal knowledge of the details on the ground. This led at first to the occasional omission of detail, such as clumps of trees, which though very prominent on the ground did not

appear to be so on the large-scale map. To meet this difficulty, prints from the reduced photographs are now examined on the ground by highly trained men, who eliminate unimportant detail, and add important features that have accidentally been omitted during the process of reduction. The prints are also examined, in a more general manner, on the ground, by an officer, and the names that are to appear on the 1-inch map are also checked by an officer.

In this manner we try to ensure accuracy, and avoid overcrowding of detail and names; and I think the sheets that have been published during the last year will bear comparison with the maps of any country. It must be remembered in comparing the English 1-inch map with the maps of other countries, that whilst the latter, on scales analogous to the one inch, are military maps, the military character of the 1-inch map has had to give way to the civil requirements of the State. There is, too, no country in the world which is so covered with artificial features, houses, roads, railroads, etc., as England; and the representation of even a selection of these must overcrowd a map on a small scale. There are, it may be remarked, quite as many complaints of omissions as of overcrowding, and features which some people consider to largely enhance the value of the map are denounced by others as useless and disfiguring.

The old system of engraving the 1-inch map was in the first place to engrave all the outline and writing upon a plate of mercantile copper. A matrix was then taken by the electrotype process, and from this a duplicate copper-plate was made, upon which the contours were engraved. This plate was used for printing the copies sold in outline, without the hill features. The hill features were afterwards added to the original plate. This system had one great disadvantage, that whenever a new railroad or road was inserted on the plate, the hills were damaged, and had to be repaired at great cost, but it had the advantage of requiring only a single printing. The introduction of the steam copperplate press has enabled us to bring the present system into use. All the outline, including the contours, is now engraved on one plate, and the hills on another; and the hill impressions are produced by double printing. The hill plate will now never require repairing, and will always preserve the character given to it by the original engraver. It is also possible to print the hills in any colour.

The electrotype process is used to produce duplicates or facsimiles of the engraved plates, which show signs of wearing after 700 or 800 impressions have been printed. The electric current was formerly obtained from voltaic cells of Smee's pattern; but these have been replaced by a dynamo driven direct by a Willans high-speed engine. The system of steeling the surface of the plates is also now used.

Line-engraving is a very slow process, and it is difficult to find engravers with sufficient skill and artistic taste to engrave the hill features on the 1-inch map. We have, therefore, for the last two years, been trying to discover some more rapid process, and one that should combine on the same map the mathematical accuracy of the contours, with the pictorial effect of hill-shading. We have, unfortunately, only been successful to a certain extent, but the difficulty seems to have been overcome by a

German publisher, Herr Petters, who has produced a very good result from one of the brush-drawings of the 1-inch map.

The processes of the survey were described in great detail, in a series of papers communicated to *Engineering* in 1888 by Captain Sankey, to which I would refer those who are interested in them. A very good general account, of which I have largely availed myself, is contained in a lecture given by Major Washington, R.E., at the School of Military Engineering, Chatham.

There are some points connected with the survey to which I should wish to draw attention.

The revision of the Survey has unfortunately fallen very much in arrear; so much so, in fact, that in many places revision means a re-survey. The necessity for a revision has frequently been pointed out by the officers who have had charge of the Survey; but it was not authorised until December 1886. The question of revision is purely one of money. It is, I think, hardly possible for the Survey Department, with its present staff, to overtake the heavy arrears, and get the map of the country into a normal state; but those arrears once cleared off, it would be a simple matter to revise the country once every fifteen years, and town districts oftener.

In view of a periodical revision, I have roughly divided the kingdom into revision districts, and as opportunity offers I am moving the division officers into centres, which will probably be permanent. Thus, the division officer at Edinburgh will, as the revision of Scotland progresses, be responsible that the revised plans are afterwards kept fairly up to date. I propose to invite the surveyors of the large towns to place themselves in communication with the division officer, and to inform him annually of extensive improvements or additions. These would be surveyed every two or three years, and transferred to the large negatives which are kept at Southampton. In this manner the plans of the large towns will be kept well up to date. The plan that I am adopting will allow no new work to fall into arrear; the time when old arrears will be cleared off depends entirely on the annual grant to the Survey.

In the utilisation of the Ordnance Survey maps the Irish Government is quite twenty-five if not fifty years in advance of Great Britain. In Ireland townland boundaries and areas, as ascertained and shown upon the Ordnance Survey maps, are the legal boundaries and areas of the townlands, and they can only be altered with the sanction of the Lord Lieutenant and Privy Council of Ireland. As there are rather more than 62,000 townlands in Ireland, averaging a little over 300 acres each, it will be seen that that country contains a large number of small, practicable, and well-defined units, from which all other divisions, such as parishes, baronies, counties, unions, and electoral divisions can be built up. Disputes as to townland boundaries are unknown. It may be added that no private boundaries are shown on the plans; the Ordnance Survey only deals with administrative boundaries.

The Irish Valuation Acts provide that the Ordnance Survey maps are to be used in ascertaining the areas of tenements, and a very good system of valuation is in force. The cost of the original tenement

valuation was $3\frac{1}{4}$ d. per acre, or £10 a square mile, and this included the marking of the tenement boundaries on the Ordnance maps; the computation of the areas; the valuation of the land, buildings and all other property; the settlement of appeals; and the issue of final lists for rating purposes. The time occupied in each county from the commencement of the valuation to the issue of the valuation list was about two years.

In Ireland, too, the maps are used in all transactions affecting land under the various Land Acts; and it may be said that, as the great "Down" survey was made the instrument for conveying to the adventurers and soldiers of Cromwell's army lands taken from the old Celtic owners, so the Ordnance Survey has become the instrument for conveying the same lands to the tenant descendants of those owners who have been enabled to purchase their holdings by recent Land Acts.

In Great Britain the case is very different. The boundaries and areas on the Ordnance Survey maps are not legal, and the maps are very rarely used for local assessment or administrative purposes. The nation deliberately undertook this elaborate Survey, on the ground that no private enterprise could accomplish it satisfactorily; and now, after spending millions on its production, the country hesitates to make use of the maps in the manner intended by the able statesmen and scientific men upon whose recommendation it was authorised by the Government of the day.

It is hardly necessary to refer to the errors, irregularities, and inconsistencies of the valuation for local assessment in this country, and to the erroneous areas in the rate-books. The areas of some parishes in the Poor Law Return of 1882 are as much as from 400 to 1600 acres less than the true areas ascertained by the Survey. In one parish an owner is rated for 40 acres more than he possesses, and another owner for 84 acres less. The valuation list, directed by Section XIV. of 25 and 26 Vict. cap. 103, to be made by overseers of parishes, does not refer to the Ordnance Survey or its maps; and it may be said that, as a rule, the guardians, overseers, and rate collectors act as if there were no such maps in existence as those of the Survey.

The Ordnance Survey maps on smaller scales might also be used advantageously as the basis for the preparation of statistical maps.

The price at which the Ordnance Survey maps are sold has been much criticised, and has been compared unfavourably with the prices of foreign maps. This question is a somewhat complicated one; and it is not easy to institute a fair comparison between the selling prices of English and foreign maps. For instance, in England the map-agent receives $33\frac{1}{3}$ per cent. for handing the maps over the counter; that is, for every 1-inch impression sold, the agent receives fourpence of the shilling paid by the public; for every three-shilling 25-inch map he receives one shilling. He receives also $33\frac{1}{3}$ per cent. on the cost of colouring. Thus, if a town plan costs ten shillings to colour, five shillings has to be added to this for the agent. This, in itself, is a heavy tax on the English maps; and, it may be added, that the paper on which the English maps are printed is much superior to that used abroad. As

regards the actual cost of production, I believe England can compare favourably with foreign countries.

Since the 1st January 1885 the sale of Ordnance Survey maps has been entrusted to the Stationery Office. The Director-General of the Survey carries out the survey and the manufacture of the maps, and there his functions and responsibilities cease. As regards the disposal of the maps, he supplies the Stationery Office with such maps as it requires for sale, all arrangements for sale resting with that department.

We are, as I have said, about to commence the revision of Scotland, and there is one point connected with it which I am glad to have this opportunity of bringing to the notice of the Royal Scottish Geographical Society. I allude to a revision of the place-names,—a work in which, I hope, we may have the co-operation of this Society. Very great care was originally taken in the collection of the names, three authorities were obtained for each name, and the orthography was determined by men with a good knowledge of Gaelic. I am afraid, however, that there was too great an inclination to attribute a Gaelic origin to all names, and that in some places, more especially on the West Coast, the Ordnance Survey orthography is sometimes at fault. The following notes on the subject have been given to me by Lieut.-Colonel J. Farquharson, C.B., R.E., the Executive Officer of the Survey, who had very wide and varied experience during the survey of the Highlands and of the Western Islands.

Place-Names of Scotland.

1. In the south-eastern counties the place-names are not materially different from those in the north-eastern counties of England—*i.e.* they are probably in the main Anglo-Saxon or Frisian, with minor mixtures of Norse and Celtic.
2. In the south-western counties of Dumfries, Kirkcudbright, and Wigtown, there is a stronger element of Norse (Icelandic or Norwegian) in common with the adjoining English county of Cumberland, where nearly all the names are of Norwegian origin. This Norse element diminishes northward through Ayr to Dumbarton and Stirling.
3. North of Stirling and the Firth of Forth, in the eastern counties, the majority of the names are probably of Celtic origin, in the interior of the country entirely so, but along the eastern coast there is a sprinkling of Norse names.
4. In all the above-mentioned districts the names have been so much corrupted that their original form and their meaning are, and probably always will be, in many cases conjectural. The Norse names are more easily recognised than the other. There is not, as in Ireland, an ancient literature in which many names are recorded in their original forms; and in Ireland also it may, in nearly every case, be assumed that the names, except those applied within a recent period, are Celtic in origin. In the above-mentioned Scottish counties there has been a much

greater mixture or succession of races, with the result that there is greater uncertainty as to the language to which the name may have originally belonged. Until, therefore, the more northern counties are reached, any amount of labour bestowed on endeavouring to trace the origin or meaning of the place-names of Scotland would hardly give any satisfactory result. The only exception might perhaps be in the case of the three south-western counties named above, where such manifestly Norse names as Wigtown, Fleet, Tinwald—(I think there is a place of that name in Dumfriesshire)—Lockerbie, Gretna, Langholm, etc., might be easily enough picked out.

5. From the Firth of Clyde northward through the western counties to Sutherland, the names on the mainland are in the interior purely and manifestly Celtic, and along the coast mainly Norse or Icelandic. Many of the Celtic names of minor features are descriptions of the feature, *i.e.* the name consists of more than one Gaelic word. In such cases the name has been written in as pure Gaelic as possible on the Ordnance Survey plans. This probably is more consistent, and pleases the eye better than would have been the case if English or phonetic corruptions of the names had been written; but the result must often be very puzzling to people who are ignorant of Gaelic. For instance, Beinn Fhada (Long Hill) is a well-known mountain in the south of Ross-shire, and appears on all the old maps, as it is in fact pronounced, Ben Attow. Sgùrr Fhuaran, another prominent mountain near it, is pronounced Scour Ouran, and so on. In all the old maps, whether of the whole country or of separate counties or localities, the phonetic method of spelling was used, and in the case of villages, farms, or houses, of course the recognised, and not the purely Gaelic form, has been adopted for the name by the Ordnance Survey also.
- 6 In the case of the Norse names which prevail along the western coasts and islands, and in the counties of Sutherland and Caithness, great difficulty arose as to the proper mode of spelling. All the local authorities, or nearly all, were in favour of spelling the names in the Gaelic fashion. The best illustrations of this are the two Norse words largely used as terminals of names—Vagr or Vogr, a bay, corrupted into the (pronounced) form -vaig, or -vay, or -way; and Fell or Fjall, a mountain, corrupted into the (pronounced) form -val. There is no *v* and no *y* in Gaelic, and no *k*. Therefore the question was should Fiskavaig (Fish Bay) be written as pronounced, or in its Gaelic form Fiscabhaig? Should Stornoway be written as pronounced, or in its Gaelic form of Steornabhaigh, where *bh* represents *v*, and *gh* represents *y*? Should Roneval be written as pronounced, or in its Gaelic forms of Ronebhal, as written to all mountains (*bh* for *v*) in the Lewis survey, or Ronemhal (*mh* for *v*) as generally written in other districts?
7. There is another difficulty, namely, that the persons who collected

the names on the ground, or those who were the local authorities supplying the names to the Ordnance Surveyors, were, if enthusiasts for all names being given as Celtic or derived from Celtic words, under great temptation to supply Celtic meanings and forms where they were or should have been manifestly ill-founded. Thus, I think, nearly all the names of the most prominent mountains in the island of Rum were originally shown (taking Haskeval as a specimen) in some such form as Aisge-mheall. Here the Norse *Fjall*, *Fell*, or *Val*, has been turned into the purely Gaelic word *Meal*=a lump or eminence (of which *Mheall* is an inflexion, the *mh* being=*v* in pronunciation). And no doubt some meaning has been found, or at any rate has been endeavoured to be found, for the prefix Aisge.

If this had been done to a large extent, and I think it has been done to some extent, the place-names of these districts would have been quite misleading. There are several words used in place-names which are similar to each other in Norse and in Gaelic, but which are entirely different in meaning, and which are liable to get mixed up in the above way. For instance, the Norse terminal word *-bol*, "a farmstead," becomes in Gaelic pronunciation *-pol*; and if there is anywhere near the place a pool or lake it always is spelt *-poll* (Gaelic for pool), and assumed to take its name from the lake, although this is by no means always the case. In the island of Tiree there is a loch called Loch Vassapol. The "Vassapol" has evidently been originally "Vatus-bol"=the farm on the lake (Vatn=the Cumberland "water," as in Derwentwater, etc.=a lake). The farm name has disappeared, and the loch is now given the name Loch "Bhasapoll."

It seems probable, therefore, that the principal questions as to the place-names of Scotland which could be decided with comparative ease are only two in number, namely, the two questions upon which I should be glad to have the opinion of this Society:—

- (1) Whether names admitted to be Gaelic should be spelt phonetically with English letters; or, when they apply to natural features, in the manner in which they now appear on the six-inch map, with Gaelic letters and grammatically in Gaelic?
- (2) Whether in the case of the coast and island names there should not be a thorough revision to distinguish more clearly the Icelandic and Norwegian names from the Celtic?

I would also ask whether this Society could not, either by the appointment of a small committee of Gaelic and Norse scholars act as referees, or in some other manner co-operate in the revision of the place-names. Of course the ultimate decision with regard to the orthography must rest with the Director-General of the Survey; but I am personally most anxious, and I feel sure my successors will be so also, to obtain the advice and assistance of those best qualified to pass an opinion on the subject.