National Surveys.¹

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EVERY civilised country—I think without exception—has a national survey; that is, a survey department, or in some cases more than one department, controlled by the government. But when we come to inquire into their activities, we find considerable differences in organisation and methods and in the actual duties allotted to these departments, and it becomes a matter of interest to inquire what are, or should be, the characteristics and functions of a national survey.

One function should be the production of a map. Here we are faced with the fact that every country must decide for itself what maps it requires. Because Great Britain publishes maps on seven different scales it does not follow that South Africa need do the same. The maps required by a country depend on local conditions and circumstances. It is clearly impossible to lay down any hard and fast rules, but we may perhaps arrive at some general principles.

I have spoken of there being an infinite variety of maps, but they may be divided into different kinds and classes, and for our purpose it will be convenient to consider maps under two main headings, namely, cadastral and topographical. My own view is that it is the proper function of a national survey to make adequate provision for maps of these two kinds, cadastral and topographical, because I consider them of such great importance to any community and any country.

The functions of a national survey, and the duties for which I think it should be responsible, are as follow:

1. The national survey should be the sole survey authority in the country.
2. It should be under one control in all its operations, from the triangulation to the publication and sale of the map, and its revision.
3. It should be responsible for an accurate network of levels throughout the country.
4. It should produce, or control the production of, all cadastral maps.
5. It should produce, or control the production of, a good topographical map of the whole country.
6. Maps used for land registry or similar government purposes should be the national survey maps, or directly based on them.
7. All maps produced by or under the control of the national survey should be reproduced and should be readily available to the public.
8. Adequate provision should be made for the revision of all maps.

Let us now consider some of the national surveys of the world, and see to what extent they comply with, or differ from, the standard which I have laid down.

Taking the surveys of Europe first, we find a strong likeness among them. They all, or nearly all, have certain characteristics in common. These are, first, that a military department is responsible

for all topographical mapping in the country; second, that such cadastral maps as exist are produced by an independent department; third, that it is very rare to find cadastral maps published. The view taken generally in Europe is that good topographical maps are a prime necessity for military purposes, hence the military character of their topographical surveys; that cadastral maps have no military value, and are chiefly required for revenue purposes; and that such cadastral maps are documents mainly for government use, or for occasional reference by the public, so that reproduction and publication are unnecessary. As a result of these views we find that, generally speaking, European countries have good topographical maps.

The Survey of Egypt has a wide reputation for excellence and efficiency, and it is fair to note that its organisation and development are due almost entirely to British control and supervision. In Egypt we find one survey department, responsible for all survey operations, including levelling.

It may fairly be said that Canada is showing a fine example in carrying out systematic surveys of her territories, surveys geodetic, topographical, and cadastral. At the same time I do not think that the organisation of surveys in Canada or in the United States is one to be copied. It is fairly obvious that there has been in the past a great deal of independent and un-co-ordinated effort in both countries and that the present situation, while no doubt working well practically, is a compromise; and the suggestive and advisory functions of a board can never, in my opinion, take the place of the personal control of a director.

The Survey of India has deservedly a world-wide reputation. It is a highly organised and admirable survey, which in its geodetic and other scientific work can bear comparison with any other in the world. On the mapping side its activities are, however, confined solely to topographical work. The Survey of India produces maps on the scales of 1-inch, $\frac{1}{2}$ -inch, and $\frac{1}{4}$ -inch to the mile, as well as various smaller scales. Revision of these topographical maps is contemplated, but exists more in theory than in practice. The Survey prints and publishes its own maps.

Cadastral work in India is done on a provincial basis. A native official called the *patwari* of each village is responsible for keeping up-to-date a map of his village, with its property boundaries. In some provinces the technical part of these surveys is done under an officer lent by the Survey of India.

Ceylon has a first-rate survey, which is responsible for all operations; and the same applies to the Federated Malay States Survey. Similarly, most of the African Colonies and Protectorates have a single survey authority, responsible for all survey work in the country. Examples are the Gold Coast, Nigeria, and Uganda, in which, although the survey is in an early stage and much territory remains to be done, the organisation and the

¹ From the presidential address to Section E (Geography) of the British Association, delivered at Cape Town on July 23.

programme of work are complete and comprehensive, and often include schools of training for natives, and full equipment for reproducing and printing their own maps. On the other hand, we get Nyasaland, with a 'Lands Officer' and a negligible staff; and Northern Rhodesia, where a very small staff is wholly occupied with cadastral work, and has neither the means nor the opportunity to undertake much-needed trigonometrical and topographical work.

In both Australia and New Zealand a great deal of cadastral work is done, in the form of surveys of property and lands, frequently isolated; but in neither country is there, so far as my information goes, any system of cadastral survey organised on the lines we have been considering.

New Zealand has a few topographical maps, mainly of manœuvre areas, produced under the military department. In Australia topographical maps are, according to my information, almost completely lacking. New South Wales has a triangulation of the highest class, and a certain amount exists in other States. Proposals have been made for carrying out a geodetic survey of the whole of the States under Federal arrangements; but these proposals contemplated only the establishment of first and second order triangulation, and so far as I am aware did not even entertain the idea of carrying the work through to the stage of mapping.

In any statement of the form that an ideal national survey should take, I would lay great stress on the desirability of unity of control of all forms of survey. There should be only one survey authority in a country, and there should be a single control of all survey operations from start to finish. Perhaps the chief point that strikes one in analysing the organisation of national surveys is the lack of such unity. If we except the Ordnance Survey and the Survey of Egypt, and certain British colonial surveys, such unity of control is conspicuous by its absence; and one of the most characteristic features of foreign surveys is the almost complete divorce of cadastral from topographical work. They seem to be commonly regarded as things apart.

The idea of a single department responsible for all forms of survey appears to be a British idea, as it is only in countries of British nationality or controlled by British that it is found. In fact it might almost seem that in stating what I believe to be the sound and ideal form of organisation for a national survey I was merely quoting the practice of the Ordnance Survey. But that is not so. I do not argue that the organisation that I advocate is right merely because it is that of the Ordnance Survey, but because it seems to me absolutely sound and defensible arguing from first principles. The British people have an extraordinary faculty for getting practical things done, and in the end often done well; but logical and orderly thinking out and arrangement is the last quality I would claim for them as a race. Yet it does seem to me that in survey matters the British have developed eminently logical and sound ideas and have put them most beneficially into practice.

All surveyors will agree that the idea that there

is any essential difference between a cadastral and a topographical map is absurd; the difference is merely one of degree and not of kind. It seems, therefore, logical to argue that both should be produced and maintained by the surveyor. Indeed, one may put it more strongly, for it is obviously wasteful to send one party into the field to produce one kind of map, and another to produce another kind, when one good map would serve as a basis for all kinds. In Europe the so-called cadastral maps are regarded much less as maps than as diagrams and documents necessary for the purpose of supervising revenue. They have become to a large extent the documents of a financial department. The question obviously arises whether the countries in question have suffered from this policy. If the argument that all survey should be under one direction is sound, one should be able to show that some disadvantage has resulted where this rule has not been followed. Can this be shown? Let us take France as a typical example.

France has a cadastral survey, on a large scale—usually 1:2500—made on the average about a hundred years ago. So far as one can judge—and we had opportunities for doing so during the War—this survey, though not based on any triangulation, was a reasonably accurate one. It has been left practically untouched since. The manuscript plans that one may see on application in the *mairie* of any commune show the country as it was in the time of Napoleon.

This survey must have cost a lot of money to carry out, and the map when produced must have been of great value to the country. Owing to lack of revision, the value of that map to the country has steadily deteriorated until now, when it must be widely negligible. I cannot believe that if this map had been in charge of a surveyor it would have been allowed to deteriorate in this way. I cannot believe that he would not have maintained it and made as accurate a map as possible. It appears to me, therefore, that France has definitely suffered from allowing this once valuable map to remain in charge of a purely fiscal department.

Take the question of publication. To survey and map any country is an expensive business; and it is particularly expensive to carry out a cadastral survey, presuming that it is a reasonably accurate survey, on account of its large scale and the great amount of detail that has to be mapped. Now the cost of reproducing and printing such maps is almost infinitesimal compared with the cost of surveying them; and it seems to me a 'penny wise and pound foolish' policy to refrain from the small extra expense that would be entailed by publication. The maps embody a large amount of information of value to the public, and obtained at public expense. It seems only reasonable, therefore, that this information should be made available to the public.

Human activities take very similar forms all the world over, though there may be superficial differences. Since the world began men have bought and sold houses, estates, lands; and a usual accompaniment of such sales is a map or plan. In

England, where accurate 25-inch plans exist for all cultivated and inhabited country, it is easy to obtain such a plan. In France, where the once good plans no longer have any value, they must be made afresh. Here again I think we may say that France has suffered through not carrying through her survey policy to its logical conclusion.

Another point that may be mentioned is the question of military value. European countries assumed prior to the War that cadastral maps were of no military value. As the War went on, the demand grew for maps of larger and larger scale. England was no wiser in this respect; but she was much wiser in her survey policy. Had the war occurred in England, it would have been an easy matter to supply maps of any scale required. In France how often must the armies have wished that good, accurate large-scale maps were available! As it was, we had to make those maps ourselves. We used the hundred-year-old French cadastrals, and were very glad to have them; but how enormously their value would have been enhanced had they been modern, up-to-date maps!

The conclusion seems justified that France has suffered definite disadvantages owing to her policy of letting her cadastral maps become mere documents of a financial department, and of not carrying out her survey to its complete and logical end; and the same conclusion will apply to other countries in a similar situation.

In the United States and in Canada division of responsibility of another kind used to exist. The disadvantages of such a state of things and the need for unity of control was felt, and has been met by the establishment of Survey Boards. I believe that the existing system works well and without friction, but I believe also that this is due mainly to the common sense and goodwill of the men working it, rather than to any advantages in the system.

What is the survey situation in South Africa at present? In January 1921 a Survey Commission was appointed, and in July of the same year it issued a report. This was not by any means the first report on survey questions in this country that had been made; nor was this Commission the only one that has investigated the subject; but as it is the latest, and the only one on the recommendations of which action has been taken, we may confine our attention to it. The report of this Commission is a most admirable document; and if I quote from it, my excuse must be that Government documents are seldom read except by the few who are professionally and immediately interested.

The Commission directed attention to the great waste that resulted to the country in the absence of a scientific system of carrying out cadastral surveys; it pointed out the need for greater co-ordination and unity of control in survey matters; and it dwelt very strongly and forcibly on the great need for a good topographical map of the country. The Commission made a large number of recommendations, all in the direction of securing greater unity and more reliability and scientific precision in the surveys of the country, and of making the survey more complete and comprehensive. As a

consequence of this report, in 1927 a Survey Act was passed, which gave effect to most of the recommendations of the Commission, though not to all.

The situation with regard to cadastral surveys in South Africa is difficult. A vast amount of surveys of farms and properties has been done, and exists stored in various archives. It varies largely in quality, but includes much most valuable material. But it is most difficult of access, and it has long been felt by the thinking surveyors of South Africa that more use should be made of it. The subject has been ably dealt with in an article in the *Survey Journal* for March 1924 by Mr. Whittingdale, who argues that it should be collected, co-ordinated, and plotted in the form of a regular series of cadastral plans. Whether such a work would be practicable I am not competent to say, though it is interesting to note in the same article that experimental cadastral plans, presumably made in the suggested way, have already been constructed in the office of the Surveyor-General, Cape Town. But of its desirability I have no doubt whatever. It is, to my mind, a cardinal principle that survey work that is done should be published and made available; otherwise it is largely wasted; and the preparation of a series of uniform cadastral plans of the dominion should, I think, take a high place in the Survey programme. It should not be forgotten, of course, that certain compilations of the existing farm surveys have been made in the Transvaal, Orange Free State, and Natal, but these do not quite meet the want.

The Survey Commission did not touch on the question of a regular cadastral map, but it devoted a substantial part of its report to the subject of topographical survey. South Africa is at present singularly deficient in good topographical maps, and there is, I think, little doubt that they are a crying need. The need for such a survey has been consistently advocated for many years past; and it is difficult to add anything of value to the arguments which have already so often been put forward. My excuse for speaking at all on the subject is that public apathy in the matter is so great that it is only by constant reiteration that one may entertain a faint hope that at some time a little interest may be aroused.

The Survey Commission stated that in South Africa a topographical survey is particularly necessary from the geographical circumstances of the country. It pointed out that, in the absence of waterways, roads and railways must be laid down before a country can begin to progress; and further, that irrigation and conservation of water will play a great part in the development of the land. It then stated that a necessary preliminary to undertaking any schemes of the nature mentioned was a knowledge of the topography, and that a good topographical map would save enormous sums that are continually being spent in reconnaissance, and would obviate a great amount of wasted effort. To this weighty statement we might add the enormous value of a good topographical map to all who are concerned in the government and administration of the country.

Another reason which makes the need of a topographical map of first importance is the question of geological survey. Geological information is deprived of a great part of its value until it is correctly plotted on a reliable map. Perhaps the best example and proof of this is the case of the Geological Survey of the United States. In that rapidly developing country it was felt that geological survey must be pushed on as fast as possible. The geologists found, however, that they must have good topographical maps; and there being none in existence, they set out to make them; with the result that the Geological Survey of the United States includes the topographical survey. In South Africa the same considerations apply with peculiar force; and it seems incredible in a country where geological survey and mineral development have such possibilities, that the value of a topographical map should have been so long ignored.

The present situation with regard to topography in South Africa is as follows: There is a good topographical survey (1:125,000 scale) of the Orange Free State, with an extension for a short way into the Transvaal. There is a 1:250,000 survey of Basutoland and of the northern part of the Cape Province. The latter is classed as a 'reconnaissance' survey; it is useful, but in Cape Colony at any rate scarcely adequate to the needs of the dominion. Of the remainder—about half of the Cape Province, almost the whole of Natal and the great bulk of the Transvaal—no topographical map exists. It will be seen that a vast amount remains to be done in the way of topography.

It is true that a start has been made with topographical survey of the country. The Director of the Trigonometrical Survey has been charged with this duty, and a sum of money has been allotted for it. The sum seems to an outsider, considering the immense amount of work which has to be done, to be extraordinarily small. It is something that the principle has been recognised, but no adequate progress will be made until a much larger sum is

allotted. The question is also bound up to a large extent with that of staff. So far as I am aware, the Director of Trigonometrical Survey has no permanent staff for field work, and very little for work in the office. This is to be regretted. In my view a government survey ought to have a regular permanent staff; otherwise it is liable to have fluctuations in the quality and quantity of its work which are most undesirable. It may of course be convenient, and usually is in the early stages of a survey, to have in addition a certain number on a temporary basis. The same observations apply to the staffs of the surveyors-general. In all cases there should in my opinion be a staff of permanent government employees. All experience goes to support this view. The example of Canada may be quoted. Cadastral surveys there used to be put out to contract, but this was dropped in 1915, and I am informed that all the men engaged on survey work are now civil servants. It is to be noted that the Survey Commission laid particular stress on this point, especially in the case of the trigonometrical and topographical surveys.

The most satisfactory feature in South African survey is perhaps the triangulation; it is all of good quality, and is being pushed on as fast as funds will allow; but there is undoubtedly a great need of extension in the second and particularly in the third order triangulation. Some levelling has been done, but nothing as yet in the way of closed circuits; so that levels are at present, to use a common expression, hanging in the air. All surveyors know that it is impossible to check the accuracy of any levelling, and to distribute the errors, until the work has been closed on the starting point.

South Africa has a great survey tradition behind it. Some of the greatest survey schemes were started in this country; some of the finest survey work in the world has been done in it; and some of the best surveyors of the Empire have been trained here. South Africa ought not to be content to lag behind other nations in this matter.

Obituary.

PROF. S. B. SCHRYVER, F.R.S.

BY the death of Prof. S. B. Schryver, which occurred on Aug. 21, an active worker in biochemistry—still in the prime of his intellectual powers—has passed away.

Samuel Barnett Schryver was born in London in 1869, the son of the late Lewis Schryver. He was educated at University College, London, and at Leipzig, his first appointment being that of assistant lecturer and demonstrator of chemistry at Liverpool. Afterwards he returned to London as lecturer on physiological chemistry at University College and chemist to the Research Institute of the Cancer Hospital. In 1913 he was chosen as assistant professor at the Imperial College of Science and Technology, and in 1920 he was appointed professor of biochemistry at the College. He was elected a fellow of the Royal Society last year.

About a hundred papers and notes stand to Schryver's credit. In 1890, in collaboration with Prof. J. Norman Collie, he showed that when a mixed quarternary ammonium chloride or hydroxide is heated, a mixed tertiary amine is produced, and in the following year he proved the existence of stereoisomeric quarternary ammonium compounds, thus confirming the view of Hantzsch and Werner. His work on the oxidation products of turpentine oil threw much light on the constitution of camphoric acid. Based on the fact that ammonia is liberated when sodamide and phenols interact, he devised a method of estimating these compounds. He worked on morphine, and studied the effect of feeding animals with thyroid.

Schryver's most important work was undoubtedly that connected with the proteins. He published a monograph on "The General Characters of the