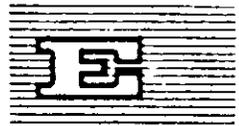


UNITED NATIONS
ECONOMIC
AND
SOCIAL COUNCIL



Distr.
LIMITED



E/CN.14/CART/19
E/CONF.43/19
7 June 1963

ENGLISH
Original: FRENCH

UNITED NATIONS REGIONAL CARTOGRAPHIC
CONFERENCE FOR AFRICA
Nairobi (Kenya), 1-13 July 1963
Item 7 of the provisional agenda

MEMORANDUM ON THE PRECISION LEVELLING CARRIED OUT BY
FRANCE IN AFRICA

(document submitted by the French Government)

MEMORANDUM

ON THE PRECISION LEVELLING CARRIED OUT BY
FRANCE IN AFRICA

(Communication from the Institut Géographique National - Paris)

I. BACKGROUND

A. North Africa (Algeria, Tunisia, Morocco)

We have to go back to the years 1887-1889 for the first geometric levellings in Africa. The traverse lengths used the main lines of Algeria and Tunisia, the datum level having been determined by a mean tide gauge installed in the port of La Goulette.

About 1911 a precision levelling network was established in Morocco, the reference point of which was a tide scale installed in the port of Barcasses at Casablanca.

Until 1914 progress was somewhat irregular, but it was not until 1920 that the polygons really took shape.

On the eve of the Second World War, the Algerian network, which was practically finished, consisted of about a dozen polygons with a total development of 8,000 km., whereas Tunisia and Morocco only had about 4,000 km. of levelling each.

That was the position in 1939 with regard to precision levelling in North Africa; it was carried out almost entirely by the Service Géographique de l'Armée (Army Geographical Service) with the help of instruments that were modern for the time and operational methods offering all the necessary guarantees, for they were similar to the instruments and methods used in the Service du Nivellement Général (General Levelling Service) of France.

But at that time the Army Geographical Service was unable to complete the work, i.e. to renew certain very old lines, repeat certain polygons with very pronounced closures, or lastly to adjust the most complete Algerian and Tunisian networks so as to give them definite datum levels and heights, because the heights had been calculated as the work proceeded in order to meet the urgent needs of the Public Works Department.

Thanks to the Institut Géographique National, the Algerian network was made uniform about 1950. The work done by the teams sent there made it possible not only to fix the closure of the main polygons but also to continue the routes southwards beyond the boundaries of the Sahara. In Tunisia the operations were limited to a route joining the network to the port of La Goulette where the final choice of datum level was made for the Algerian levelling.

For Morocco, a new, coherent and dense system was set up between 1955 and 1961, as far as the Mauritanian frontier in the south. This network, which comprises first and second order lines observed with the same accuracy, was adjusted as a whole and its heights calculated from a mean zero at Casablanca.

Lastly, since 1958 the Tunisian Topographical Service has been responsible for the re-making of its network, and up to now has carried out 3000 km. of excellent first-order levelling.

B. Equatorial Africa, West Africa

A first levelling mission composed of two operators was sent to the Chad region in 1947. Its purpose was not to plot a major base route but rather to carry out partial and fairly dense levelling over a small area in order to meet local needs.

Although the advantages derived from this first mission in "Black" Africa were modest from the point of view of overall levelling, the interest aroused by the results obtained had the consequence of ensuring the continuity of the operations in the south-westerly direction and giving the embryo levelling a datum level based on a mean sea level. Scarcely two years after the first determination of levels carried out in the heart of the Chad territory, the port of Kribi was reached. Meanwhile a mean tide gauge had been installed there, and although the observations had only been recorded there for a short time, a mean zero was determined, giving an acceptable base for calculating the heights.

Levelling was continued without interruption from 1950 to 1962 at the average rate of 3 missions a year.

In addition to the large first-order polygons covering the territory of Equatorial Africa, and always in order to meet urgent needs, second-order and even third-order traverses were set up.

Observations were made on a second mean tide gauge placed at Pointe Noire, and it is from those observations that the adjusted and final heights of the Equatorial African network were calculated.

Side by side with the levelling work carried out in the States of Equatorial Africa, work was commenced in West Africa, this time starting from a tide gauge of the Dakar Hydrographic Service, and it was possible immediately to meet the requests for heights.

From Dakar the network progressed in 3 directions in turn; these are, in chronological order:

1. Southwards to the sea via Abidjan, Conakry and Lomé, where checks by closures on mean zero were made by observations on tide scales;
2. Eastwards to the Chad to join up with the Equatorial African levelling;
3. Northwards, on the one hand to Tindouf, point of junction with the North African network, and on the other hand via two major routes across Niger and the Sahara to the Algerian network (Colomb-Béchar, In Salah).

Thus, considered as a whole, all the African territory is marked out in major base lines, connecting the Mediterranean (Tunis) with the four Atlantic ports Casablanca, Dakar, Kribi and Pointe-Noire.

II. METHODS USED, CONSERVATION OF THE NETWORKS

In addition to accuracy, the main quality required of a modern network is conservation; but in areas which are often marshy and depopulated desert regions where there are no, or very few, main works of lasting materials, the operator has had to construct the boundary marks himself and to dispatch them with the materials needed to install them in the places selected.

The density of these boundary marks varies with the difficulties of access and of supply. Usually a boundary mark has been set up every 5 km., but on certain tracks not usable by vehicles this density is reduced to one boundary mark every 10 km.

For the African territory as a whole this density is adequate, but in order to ensure the best possible conservation of the established network, it would be advisable to consider placing base boundary marks of large dimensions every 50 km. for example.

III. RESULTS OBTAINED

The first-order polygons observed are of an average length of 1,500 km. and an average closure of 150 mm; this gives a probable kilometric error of about 4 mm. per km. This value will be made more accurate in future years when certain sections belonging to polygons with abnormal closure have been recommended and when the junction is effected between certain major routes at present extending to the east of the network.

The junction of the different points of contact with the sea offered a highly efficient means of checking the operations, as well as a subject of justifiable curiosity. In this connexion it is interesting to note, following the shortest and most favourable routes, the following discrepancies between the mean zeros that were calculated:

Between Tunis and Dakar	+ 35 cm. (Tunis lower than Dakar)
" Dakar and Pointe-Noire	- 18 cm.

It is also of interest to compare the discrepancies between the mean levels of the points nearest to each other.

Dakar-Conakry	- 9 cm.
Conakry-Abidjan	- 18 cm.
Abidjan-Kribi	+ 12 cm.
Tunis-Casablanca	+ 23 cm.

Another result shows the excellent concordance of the African levellings. The height of the water level of Lake Chad at a particular moment was calculated starting from Tunis, Dakar and Pointe Noire by means of the following routes:

- Tunis, Ouargla, Fort Flatters, Tamanrasset, Agadès, Zinder, Lake Chad;
- Dakar, Bamako, Ouagadougou, Niamey, Zinder, Lake Chad;
- Pointe Noire, Lambaréné, Yaoundé, Garoua, Lake Chad.

The three values found showed a remarkable concordance.

From Dakar	281m.68
Tunis	281m.77
Pointe Noire	281m.89

It is clear that under these conditions it is possible to contemplate an overall adjustment of the African block based on three zeros: Dakar, Tunis and Pointe Noire. This adjustment, which will have to be made in the years to come, will obviate the inconvenience resulting from the existence of blocks side by side and adjusted in isolation.

- - - - -