S1955

Distr.
LIMITED

E/CN.14/CART/298
20 October 1972

ENGLISH
Original: FRENCH

UNITED NATIONS
ECONOMIC AND SOCIAL COUNCIL

ECONOMIC COMMISSION FOR AFRICA

Third Regional Cartographic Conference
for Africa

Addis Ababa (Ethiopia) 30 October - 10 November 1972

# THE WORK OF THE INSTITUT GEOGRAPHIQUE NATIONAL IN AFRICA*

## CARTOGRAPHY IN TROPICAL AFRICA AND THE SAHARA

Submitted by the Government of France

Since 1945, the Institut Géographique National has been working in the cartographic field for the North African States (Algeria, Tunisia and Morocco) and the French-speaking West and Central African States.

This short paper will attempt only to give a brief picture of the work already carried out and will deal principally with mapping work in Black Africa and the Sahara. This work although carried out on behalf of 15 States, and according to substantially different procedures does have a certain unity of concept, characterized by the establishment of the 1:200,000 basic map.

From the equatorial forest, through the savannah and the Sahelian steppe to the desert, these areas do in fact have a number of common characteristics which have a profound influence on mapping work.

One of the most important of these characteristics is the vastness of the areas to be covered.

The Algerian Sahara below the 34° parallel extends over an area of 2,100,000 km$^2$.

The French-speaking States of West Africa extend over 4,480,000 km$^2$ (Mauritania 1,030,700, Mali 1,201,600, Senegal 196,200, Niger 1,267,000, Upper Volta 247,200, Ivory Coast 322,400, Togo 56,000, Dahomey 112,600, Guinea 245,800).

---

* Par l'Institut Géographique National (IGN).

The French-speaking States of Central Africa extend over 2,990,000 km$^2$ (Chad 1,284,000, Cameroon 475,000, Central African Republic 622,900, Congo 342,000 and Gabon 267,700).

The total area of these three regions combined is 9,771,000 km$^2$, an area 17 times as large as France. We should point out that the standard mapping of our country is being carried out on the scale of 1:25,000, and that, in spite of considerable resources, it is progressing at a rate of only 1,200 km$^2$ annually. The scales and working methods used in Europe could not therefore be applied in Africa.

Another characteristic common to almost all these areas is the difficulty of carrying out ground surveys. The relief of the humid tropical regions is extremely broken, consisting of an almost endless succession of small, steep hills rising out of marshland. Only one section of the Sahelian areas offers relative ease of travel. At the approaches to the desert, the stabilized dunes, and even more so the shifting dunes, again present a very broken relief and make travel by automobile very difficult, except on a few improved routes. Almost everywhere, tracks are few and far between, in very poor condition, often impassable in the rainy seasons, and very testing for vehicles and personnel alike. In addition, there is the isolation factor, and the total lack, until recent years, of medical assistance or any local repair facilities. Consequently, the cost of field work is very high.

Added to all these difficulties, from the outset, was the pressure of urgency. On all sides, geologists, public works departments and agronomists were asking for maps providing them with a minimum of reliable information, at least as far as the planimetry was concerned.

The vastness of the area to be covered, the difficulty of moving from place to place, and almost universal under-population, combined with the pressure of urgency called for direct mapping on the scale of 1:200,000. This work comprised 827 sheets (1° of longitude by 1° of latitude, i.e. 110 km x 110 km at the equator). By 1972, 734 of these sheets had been published, at least in a provisional edition, 71 had not been subjected to any survey on this scale (but were covered by a good map drawn directly on the scale of 1:1,000,000) and 22 had been subjected only to topographical surveys carried out prior to 1945.

## Mapping prior to 1945

West Africa was the only area to have been subjected to systematic mapping. The Service Géographique de l'Afrique occidentale française (AOF), set up in 1895, embarked on the establishment of a general map on the scale of 1:500,000 by collating route surveys with the aid of astronomical stations, and also of a topographical map on the scale of 1:200,000 based on a geodetic network. By 1945, the geodetic survey covered 265,000 km$^2$ and 75 sheets on the scale of 1:200,000 had been published. 1/

---

1/ Cf.P. Traizet, le Centre de l'Institut Géographique National, Dakar, Bulletin d'information de l'IGN, N°. 10, March 1970.

These surveys vary widely in quality, but in general they are of far less value than regular maps; the representation of the relief is generalized and the hydrographic representation often defective (fig.1). The fragmentation of the relief, the short range of visibility in the wooded regions and the difficulties in moving from place to place all combined to frustrate conventional topographical survey procedures, despite the efforts of field staff.

The Algerian Sahara had been subjected to surveys on the scale of 1:200,000 under the direction of the French Army Geographical Survey, 95 sheets of which had been published in 1945. Although they are of varying quality, these suveys were on the whole sufficiently reliable to enable topographical information such as the location of wells and place names to be subsequently transferred to the modern photogrammetric surveys, thus obviating the need for a new ground survey.

The situation in Equatorial Africa was completely different. These territories, which are especially under-developed and under-administered, had not been subjected to any systematic mapping until 1945. The only document in existence was a preliminary plot on the scale of 1:1,000,000, which was established in 1935 on the initiative of the Ministry for the Colonies, and in which an attempt had been made to compile a rather unreliable synthesis of the sketch maps prepared by administrators for their tour reports,without any field work and with very few known astronomical stations; position errorswere as great as 30 km (fig.2). In effect, practically nothing was known about the area.

Establishment of IGN Overseas Annexes

The Dakar annex, established in 1945, extended its field of activity to cover all the French-speaking West African States, while at the same time the Brazzaville annex, which was set up in 1946, worked on behalf of the Central African States. The Yaoundé Centre, which was established in 1948, was assigned the separate task of working exclusively in Cameroon.

These centres were strengthened by temporary missions from France and by the secondment of a number of military personnel (officers and NCO's). The task assigned to them was to establish a map on the scale of 1:200,000 on the spot and in the shortest time possible. Between 1945 and 1972, this mapping passed through several stages, from the simple mosaic of road routes, to the standard map. During this period, while aerial photographic coverage was progressing, new technical resources were brought into use and concepts developed considerably.

Aerial photographic coverage

Since 1944, the AOF Geographical Service had been using Trimetrogen photographic coverages carried out in 1943 by the United States Air Force over a large portion of Africa, North of the 8° parallel, with a view to the rapid establishment of an aerial navigation map on the scale of 1:1,000,000. These photographic coverages were based on East-West flights about 20 km apart; at each photographing point, a vertical photograph was taken, together with two oblique phtographs, inclined at an angle of 60 degrees to the vertical and perpendicular to the line of flight. The oblique photographs could be made use of by either graphical construction or photographic rectification.

The Trimetrogon aerial coverages were also used by the IGN Dakar and Brazzaville annexes from 1947 to 1952 to establish provisional maps, notably in the Sahelian areas. In spite of the ingenuity employed in interpreting the oblique photographs, the results obtained were disappointing. All these maps had to be recommenced while the vertical aerial coverage, which was carried out by a specialized fleet of IGN aircraft was continuing.

The scale chosen for the execution of this photographic coverage was 1:50,000; only certain regions of the Algerian Sahara have been covered on smaller scales (1:80,000 to 1:90,000), with a view to showing the geological structures more clearly; initially, only panchromatic emulsions were used. From 1955 onwards, it became increasingly standard practice to use panchromatic + black and white infra-red photographs taken simultaneously, since the latter gave better rendition of vegetation and eliminated the effects of haze.

If the overlaps are regular, one sheet on the scale of 1:200,000 is covered by about 400 23 x 23 cm photographs, or 550 18 x 18 cm photographs.

Considerable difficulties were encountered in the execution of vertical aerial photographic coverages of these vast areas:

- Because of the lack of accurate maps, it was not possible to plot the position of the aircraft in relation to the details identified on the ground. During the first few years, it was not possible to obtain regular overlaps. It was necessary to increase the number of strips, which added to the cost burden and made it more difficult to use the photos for mapping purposes. These difficulties were gradually overcome. From 1950, the crews of the IGN aircraft were able to carry out regular photographic coverages of unmapped areas.

- The period of the year when the meteorological conditions are favourable to photographic coverage becomes progressively shorter the closer one gets to areas with high annual rainfalls. Even in the Sahelian zones, the favourable season spans scarcely five months of the year (November to March); this period corresponds exactly to the bush fire season and is accompained by intense haze. The images obtained are often mediocre, and although they are generally suitable for cartographic purposes, they do not enable any estimate to be made of areas under cultivation, since at this season the fields are being harvested, burned off, or trampled by livestock. Rural development studies require photographs taken specially for them under conditions which are recognized as favourable.

-In areas of high rainfall, particularly the south regions of Cameroon and Gabon, favourable weather conditions occur for only a few days each year. The photographic coverage of these areas called for a long series of photographic missions, repeated year after year. On occasion, the aircraft remained idle at Douala for over two months without a single favourable day presenting itself. Super-wide angle cameras were used, covering 23 x 23 cm with an 88 mm focal length lens, together with infra-red emulsions. Using these methods, it was possible to complete the aerial photographic coverage, one strip fragment at a time. There are still some gaps in this aerial coverage, however, (about 10,000 $km^2$ for Gabon and Cameroon).

The photographic coverage of the States included in the present study was spread over a period of twenty years. The bulk of the work was completed in 1965. Figure 3 shows the five-year period in which photographic coverage was carried out. The breakdown of the data relating to 827 sheets on the scale of 1:200,000 gives the following figures:

| | | |
|---|---|---|
| 1945 to 1951 | : | 57 (7 per cent) |
| 1952 to 1956 | : | 339 (41 per cent) |
| 1957 to 1961 | : | 283 (34 per cent) |
| 1962 to 1966 | : | 90 (10 per cent) |
| 1967 | : | 58 (7 per cent) |

This table shows how outdated the aerial photographic coverage is; this is made all the more serious because the oldest coverage is of the most important areas, which were generally the first to be photographed. Regular repetition of the aerial photographic coverage (in France it is carried out every 10 years) is absolutely necessary. This point will be taken up again later.

The first order control network

The geodetic triangulation and precise levelling work carried out in Morocco, Algeria and Tunisia, was almost entirely executed prior to 1940, that is to say before the establishment of the IGN. The precise levelling network of Tunisia was established by the Service topographique tunisien.

Since 1945, most of the IGN's work has been undertaken south of the 34° parallel, which marks approximately the northern limit of the Sahara.

Except for certain very hilly areas (south-west Cameroon), it was necessary to abandon the idea of establishing a geodetic network, since it would have been too costly and would have required too long to complete. Mention should be made, however, of the IGN's participation in the 12° parallel work, an international undertaking designed to show up land forms, and which has resulted in the establishment of a geodetic chain, stretching across the whole continent from Dakar eastwards.

The first order control network to be used for mapping purposes was based on astronomical stations of which there were 4 or 5 to each 1:200,000 sheet; it was possible to select most of these stations along routes accessible to road vehicles, which greatly facilitated observation.

The altimetrical control network was made up of precise levelling loops, established by the same methods as are used in France, and with the same degree of accuracy.

The work carried out over these three areas as a whole, Algerian Sahara, West Africa and Central Africa - is shown by the following figures, established on 1 June 1972:

- 3,942 astronomical stations
- 86,240 km of precise levelling traverses.

Figure 4 shows the extent of the work carried out, together with the relationship between the density of the control points and the economic importance of the territories. The level loops are particularly dense in areas of high population density (south-east Cameroon, southern Ivory Coast) and flood plain areas (Logone basin, Inner Delta of the Niger). In the Sahelian and desert areas, the networks are less dense, but no region has been overlooked. Three junctions were made across the Algerian Sahara between the Atlantic and the Mediterranean, and another across Mauritania between Casablanca and Dakar.

The following figures give an idea of the degree of accuracy obtained:

- From Dakar to Pointe Noire (8,641 km): 18 cm;
- From Dakar to Tunis - La Goulette via Gao (7,134 km): 35 cm;

Elevation of surface of Lake Chad (Nguigmi, 6 May 1954).

- From Dakar : 281.68 m
- From Tunis - La Goulette: 281.77 m
- From Pointe Noire : 281.88 m

The results of this work, which was remarkable both for the extent of the area covered and for the degree of accuracy achieved, are unfortunately threatened by erosion, the intensity of which had been under-estimated. The beacons, which were not sufficiently deeply anchored, have gradually become exposed and there is now a risk that they will disappear one after another. The beaconing must be redone if this valuable network is to be preserved.

The minor control network

Plotting from photograph calls for a dense network of points of known elevation (at least four for each pair of photographs). In France, for regular large-scale surveys, these determinations are carried out without any difficulty by means of theodolite sightings on the geodetic points of the 1st order control network. This method was totally inapplicable in tropical Africa. It was at this point that the greatest difficulties were encoutered, and as a result, for almost 15 years (1945-1959), regular surveys could be conducted only over small areas.

The only procedure available at the time was barometric levelling, by comparison with recording stations of known elevation. This procedure gave a satisfactory degree of accuracy (standard error about 2.50 metres), but called for extensive field work in uninhabited bush areas, far from any track, which was costly and sometimes exhausting for the field staff. In fairly flat areas, an effort was made to cut down field work by establishing river profiles by interpolation, and sometimes by rather risky extrapolations.

Aerial triangulation, which was developed about 1950, but only came into fairly general use from 1955 onwards, brought a completely new solution. In this procedure, the minor control network points are selected from the photographs themselves then determined by calculation on the basis of the measurements made on the negatives, either by passing the pairs through plotting equipment, or by using a high accuracy stereocomparator. The determination of elevations involves highly complex calculations, and, in spite of the programmes that have been devised to enable the calculations to be made by computer, the procedure remains costly. It is the preferred method for equatorial forest areas, where no other procedure can produce comparable results; treetops can be used as minor control points.

1959 saw the introduction of a new technique brown as Airborne Profile Recorder (APR). This technique consists of making flights at medium altitude, following the overlap areas of the strips of photographs for which one wishes to establish control networks. Measurements are made by echo soundings from the plane to the ground, the altitude of the aircraft being determined by barometric levelling using a hypsometer.

The accuracy of APR is less than that of barometric levelling on the ground (standard error in elevation - 4m), but the procedure is economical and permits rapid photographic coverages of large areas. The technique is not valid in wooded country, however.

The introduction of APR in 1959 gave cartography new impetus, making it possible to establish standard maps on the scale of 1:200,000, which had previously been exceptional.

The following figures give a picture of the development of these techniques. Between 1969 and 1971, the areas covered by APR and by aerial triangulation were as follows:

| | APR | Aerial triangulation |
|---|---|---|
| Algerian Sahara | 1,365,000 $km^2$ | 230,200 $km^2$ |
| West Africa | 922,000 $km^2$ | 569,000 $km^2$ |
| Central Africa | 252,000 $km^2$ | 548,000 $km^2$ |
| Total | 2,539,000 $km^2$ | 1,347,200 $km^2$ |

1:200,000 mapping using vertical aerial photographs

It is relatively easy, at least in fairly flat country, to establish a planimetric base map from vertical aerial photographic coverage. But establishing maps giving an accurate representation of relief by means of contours and spot heights is a completely different problem, which can only be solved by establishing an altimetric minor control network, and by the use of stereoplotting equipment; these alone are capable of producing an accurate scale drawing of the terrain from aerial photographs.

These considerations give an idea of the variety of mapping procedures, as shown in fig. 5. They illustrate the continual development of techniques since 1946. Many 1:200,000 sheets pass through numerous stages, before reaching the final stage, that of the standard map.

- Planimetric maps represent the most rudimentary way in which vertical aerial coverages may be used for cartographic purposes. The planimetric minor control network is established (as is also the case for the more elaborate procedures) from aerial photographs by photo-triangulation, using the simple and economical slotted template method.

- A second type of map (established principally between 1946 and 1959, before the introduction of the APR control network), comprises a representation of relief forms by means of form lines drawn by simple examination of the photographs under a stereoscope. This representation was really useful, particularly to geologists, since it showed the main tectonic features. But it constituted only a temporary solution, until technical means could be found of establishing standard maps.

- Planimetric maps of desert regions represent a special formula well-suited to the immense Sahelian and desert tracts north of the 16° parallel, which are generally very featureless or are made up of low tablelands.

These maps represent the relief by means of the most important planimetric lines (edges of escarpments, etc.), and the geomorphological nature of the terrain (shifting or stabilized sands, reg, etc.) by means of shades. Although this type of map is itself only an intermetidate step towards complete knowledge of the area, it retains its functional value and still constitutes one of the aspects of recent cartographic programmes. It is probably destined to remain, for a long time to come, the only map of these barren areas.

- Standard maps comprise a representation of the relief by means of heighted contours at 50 metre intervals, with intermediate contours at 25 metres. Only the use of stereo-plotting equipment can satisfy these standards and produce an accurate scale-drawing of the terrain; this formula, which was made practicable by the APR altimetric control network, constitutes the only technically correct solution, and its cost, field completion included has proved to bet not much higher than that of provisional maps. As shown by the figures given in the paragraph below, this formula is tending gradually to supplant planimetric maps, except, as has already been stated, for the Sahelian and desert regions.

The plot is made directly on the scale of 1:200,000 or 1:100,000. The Dakar and Brazzaville annexes used apparatus which was simplified but based on the correct principles (Stereoflex). The IGN Photogrammetry Service carries out this work in its own shops, which are equipped with more expensive apparatus, designed for regular surveys. Although the issue has not been finally resolved, and although simplified equipment is useful in mapping countries with only modest means, it appears that, in the final analysis, calculating the amortization of the equipment over a period of twenty years, such equipment does not result in any substantial saving.

The maps established by the Dakar and Brazzaville Centres among others can be defined as semi-standard in that the contours were traced with the aid of a stereoscope and adjusted to the altimetric control network, either directly in the shop, or in the course of field completion (this latter procedure was used mainly in Dakar). When used by experienced topographers, and in relatively featureless terrain, this method can produce maps which are adequate for the needs of most users, without, however, attaining the degree of precision obtained by stereoplotting. This formula, the cost of which is not appreciably lower than that of plotting, has fallen into disuse. It is now used in only flat terrain, in order to delineate one or two contours from an APR control network.

The following table summarizes the 1:200,000 mapping established by IGN for the whole of the Algerian Sahara, West Africa and Central Africa (situation as at 1 July 1972):

| | |
|---|---|
| - Sheets not prepared | 71 |
| - Sheets prepared without use of vertical aerial photographs | 22 |
| - Sheets prepared from vertical aerial coverage | |
| Planimetric base maps with no representation of relief | 63 |
| Representation of relief by form lines | 52 |
| Planimetric base maps of desert regions | 192 |
| Regular and semi-regular maps | 426 |
| Total[1/] | 827 |

This table includes only the work of the IGN. A small number of maps have been established, mainly for the Algerian Sahara, by foreign companies, and are not known to us.

Map on the scale of 1:50,000

This map constitutes a new stage in the cartographic representation of Black Africa. The scale of 1:50,000 allows accurate representation of human settlement and vegetation. It also allows very accurate representation of relief forms by means of contours at 20 metre intervals with intermediate contours at 10 metres; these are generally adequate for the drafting of plans for road alignments. It is therefore highly useful for all development activities.

Side by side with the establishment of the 1:200,000 surveys, considerable efforts were devoted to regular photogrammetric surveys on the scale of 1:50,000, notably in Guinea, Cameroon, Ivory Coast, Togo (the whole of which was covered on this scale), Senegal and Niger. On 1 July 1972, 962 sheets were published, representing a total area of 580,000 km$^2$ (Fig. 6).

Generally speaking, these maps have undergone only very limited field completion; considerable effort is still required in this respect.

Some statistics

The table below summarizes, on a yearly basis, the main activities of IGN in the three areas studied as a whole.

No figures have been included for 1946 or 1947, since only preliminary work was carried in those years.

---

1/ Account has been taken of the sheets which are incomplete, include an expanse of sea in the area covered, or spill over into countries not included in the mapping area, by including only the relevant area, with a quarter-sheet being taken as the basic unit.

| Year | Aerial photographic coverage (area km$^2$) | Astronomical stations (number) | Precise levelling (km) | Planimetric surveys (area km$^2$) | Plotting on scales of 1:100,000 or 1:200,000 (area km$^2$) | Plotting on sclae of 1:50,000 (area km$^2$) |
|---|---|---|---|---|---|---|
| 1948 | 18,825 | | | | | 460 |
| 1949 | 176,884 | 69 | 807 | (1) | | 1,009 |
| 1950 | 130,050 | 110 | 1,888 | | | 7,871 |
| 1951 | 601,775 | 92 | 3,889 | | | 45,811 |
| 1952 | 527,383 | 139 | 6,190 | | | 27,157 |
| 1953 | 938,625 | 272 | 7,642 | | | 29,060 |
| 1954 | 1,921,477 | 273 | 8,930 | | | 28,266 |
| 1955 | 1,933,763 | 498 | 7,822 | | | 44,611 |
| 1956 | 1,635,758 | 222 | 8,353 | 374,580 | | 52,895 |
| 1957 | 966,320 | 294 | 5,881 | 518,500 | | 34,199 |
| 1958 | 493,503 | 565 | 7,112 | 680,500 | 92,960 | 48,486 |
| 1959 | 611,988 | 528 | 5,372 | 553,100 | 261,921 | 56,208 |
| 1960 | 655,084 | 206 | 3,991 | 271,000 | 203,908 | 54,241 |
| 1961 | 554,633 | 95 | 3,574 | 461,800 | 289,930 | 27,036 |
| 1962 | 190,084 | 244 | 5,392 | 370,000 | 221,530 | 24,822 |
| 1963 | 471,053 | 89 | 1,263 | 458,300 | 121,283 | 39,091 |
| 1964 | 495,419 | 93 | 3,055 | 382,500 | 219,808 | 60,866 |
| 1965 | 270,880 | 72 | 1,468 | 347,800 | 273,690 | 82,550 |
| 1966 | 116,153 | 64 | 1,156 | 334,000 | 59,355 | 73,864 |
| 1967 | 174,234 | 9 | 436 | 259,800 | 45,350 | 44,510 |
| 1968 | 149,607 | 23 | 298 | 225,000 | 117,555 | 57,530 |
| 1969 | 159,071 | - | 423 | 155,400 | 179,317 | 41,937 |
| 1970 | 236,020 | 5 | 665 | 97,958 | 133,581 | 50,927 |
| 1971 | 141,493 | - | 633 | (2) | (2) | (2) |

(1) Statistics not available or dubious for the period prior to 1956.

(2) Statistics for 1971 are uncertain due to disruption of work as a result of the dissolution of the Dakar and Brazzaville centres.

These figures show a marked decline in the volume of work since 1965, due partly to the fact that the basic mapping was adequate to satisfy most needs and that the first aerial coverage had been completed.

Reorganization of IGN activities in Africa

Since 1960, the African States have gradually been assuming control of their cartographic activities and have established national services. The Institut national géographique now acts only on a consultancy basis, together with other organizations. The Dakar and Brazzaville Centres have been closed and replaced by agencies essentially responsible for maintaining liaison with the national services, in the same way as the agencies established in the other States.

Such cartographic work as is requested is now carried out in Paris, after temporary missions have been dispatched to the area in question.

Conclusion

The Institut Geographique National has helped the French-speaking African countries to build up a valuable stock of basic and cartographic materials, remarkable for the unity of conception which has guided its preparation and the extent of the field completion work involved.

This stock will retain its value only if it is subjected to regular revisions. In France, as has already been mentioned, aerial photographic coverages are repeated every ten years and maps are subjected to periodic revision. With the exception of the desert regions, Black Africa faces the same problem exists in Black Africa, but to a more acute degree, since in recent years, numerous roads or tracks have been opened, with far-reaching effects on settlement. The example given in figure 7 can in no way be considered as the exception. Such revision is impracticable unless it is preceded by new aerial photographic coverage.

The replacement of at least some of the bench marks which could disappear as a result of erosion, also constitutes a very serious problem.

We can only bring these problems to the attention of the national services of the African States.

J. HURAULT

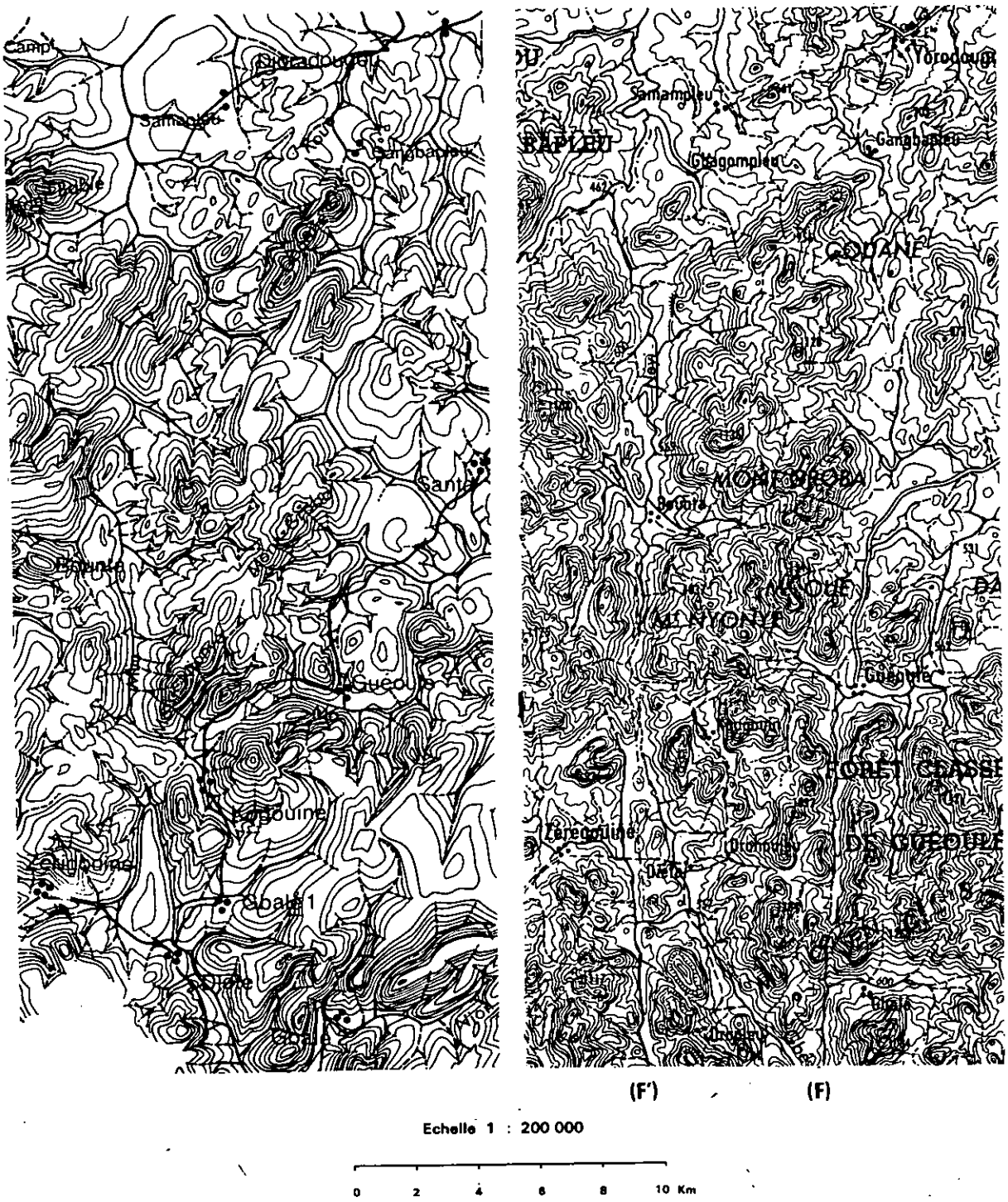



Fig. 1 — Ce que l'on connaissait de l'Afrique Occidentale avant les travaux de l'I.G.N. A gauche : extrait de la feuille au 1 : 200 000 de Man (Côte d'Ivoire) résultant des levés topographiques effectués vers 1925. A droite : extrait de l'édition 1971 résultant d'un levé photogrammétrique.

La comparaison de ces deux documents montre l'impuissance du levé topographique terrestre en forêt tropicale. En dépit de leurs efforts, les opérateurs n'ont pu mettre en place de façon satisfaisante que les villages et le réseau des pistes. Le relief n'est exprimé que dans ces grandes lignes, et la représentation du réseau hydrographique est défectueuse. Les deux grandes fractures F et F', nettement apparentes sur le levé photogrammétrique, n'ont pas été mises en évidence.

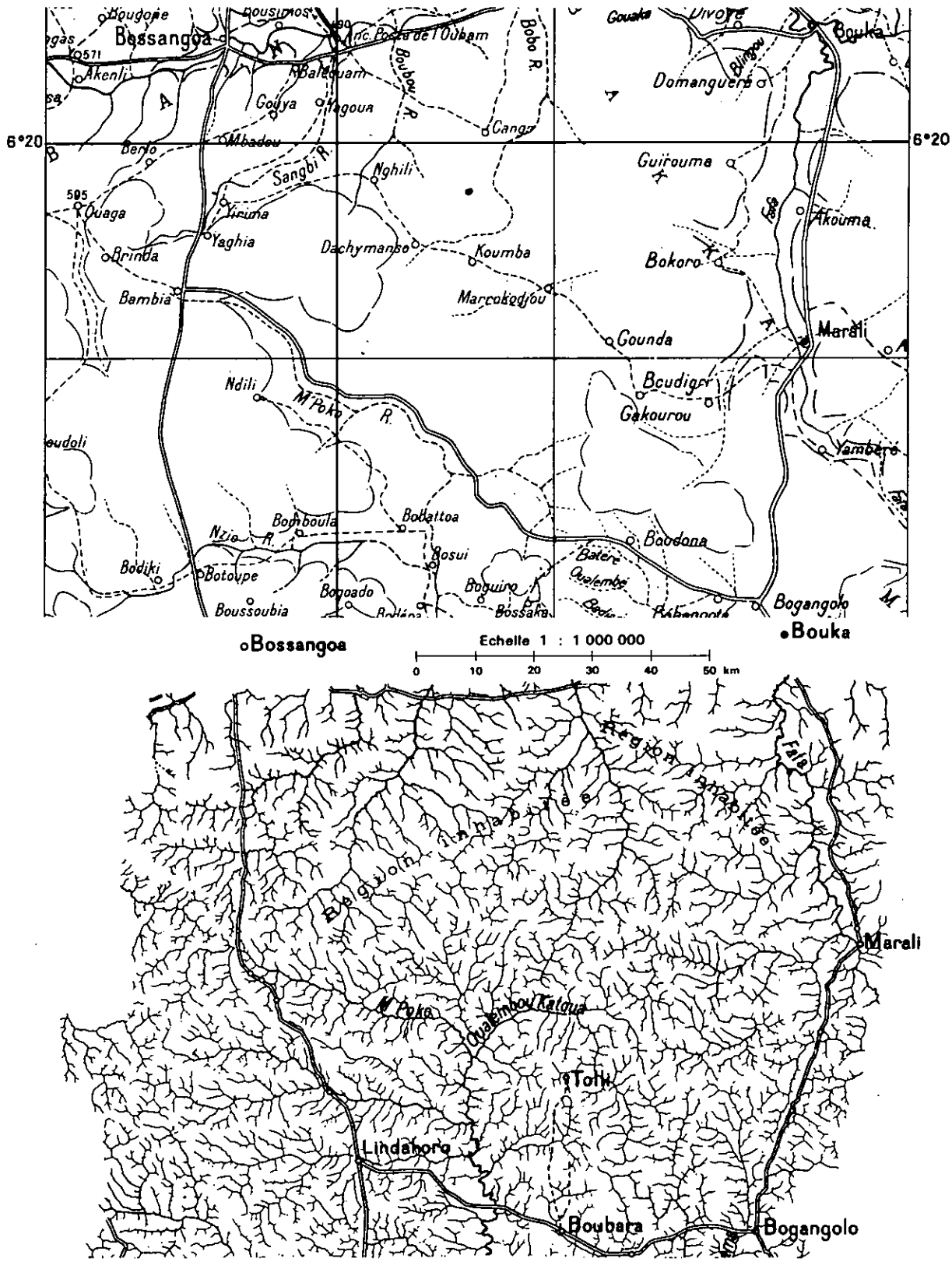



Fig. 2 — Ce que l'on connaissait de l'Afrique Equatoriale avant les travaux de l'I.G.N. Partie supérieure : fragment de l'esquisse au 1 : 1 000 000, feuille de BANGUI (République Centrafricaine) édition 1937. Partie inférieure : configuration véritable de la région, d'après les levés photogrammétriques. La carte de 1937, établie d'après des itinéraires de tournées, ne comporte qu'une représentation très grossière des principales rivières ; les erreurs en planimétrie dépassent parfois 30 km. La représentation du relief est sans aucun rapport avec la réalité.

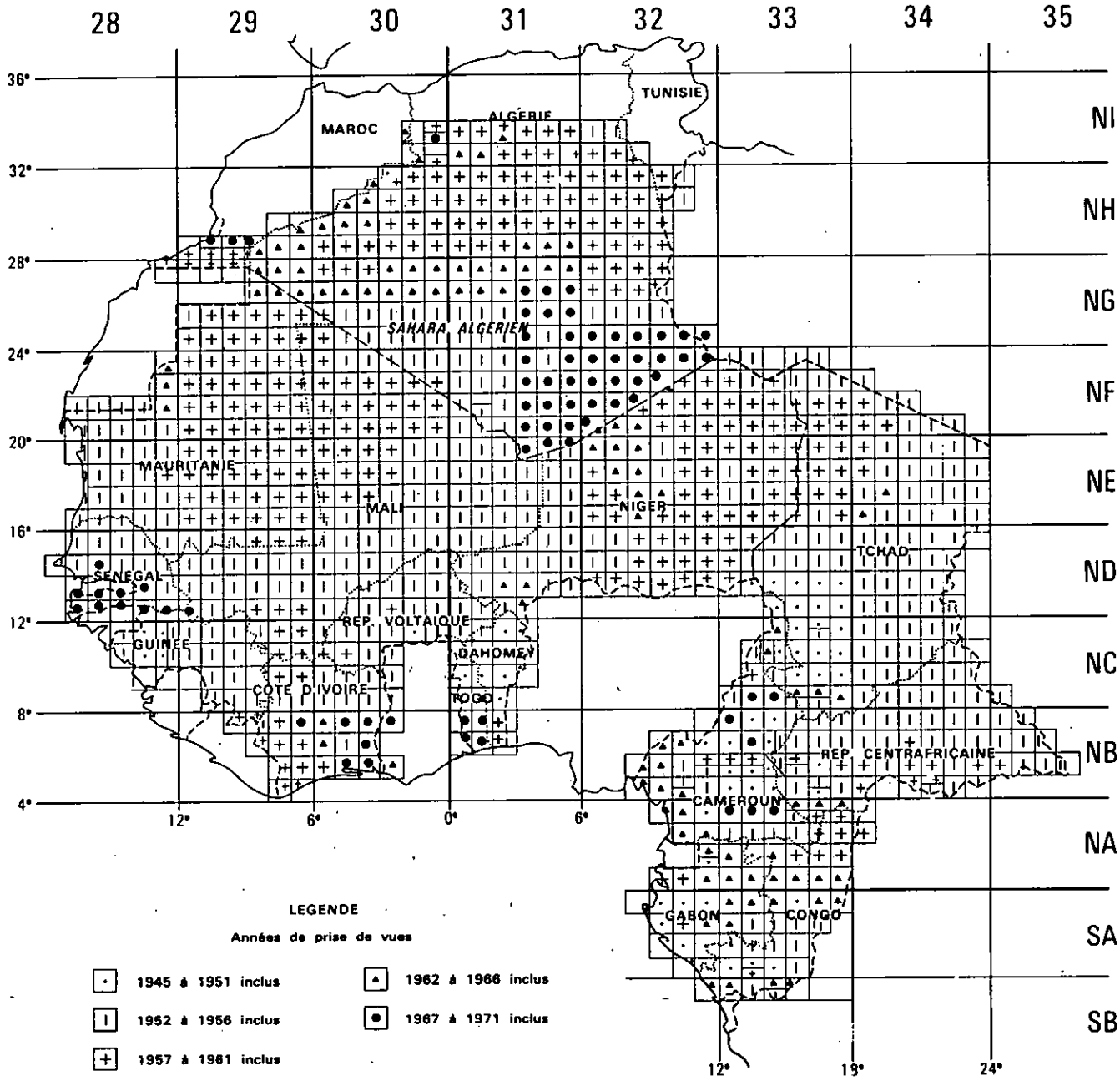



Fig. 3 — La couverture photographique aérienne effectuée en vue de la cartographie au 1 : 50 000 et 1 : 200 000. Etat d'avancement au 1er juillet 1972.

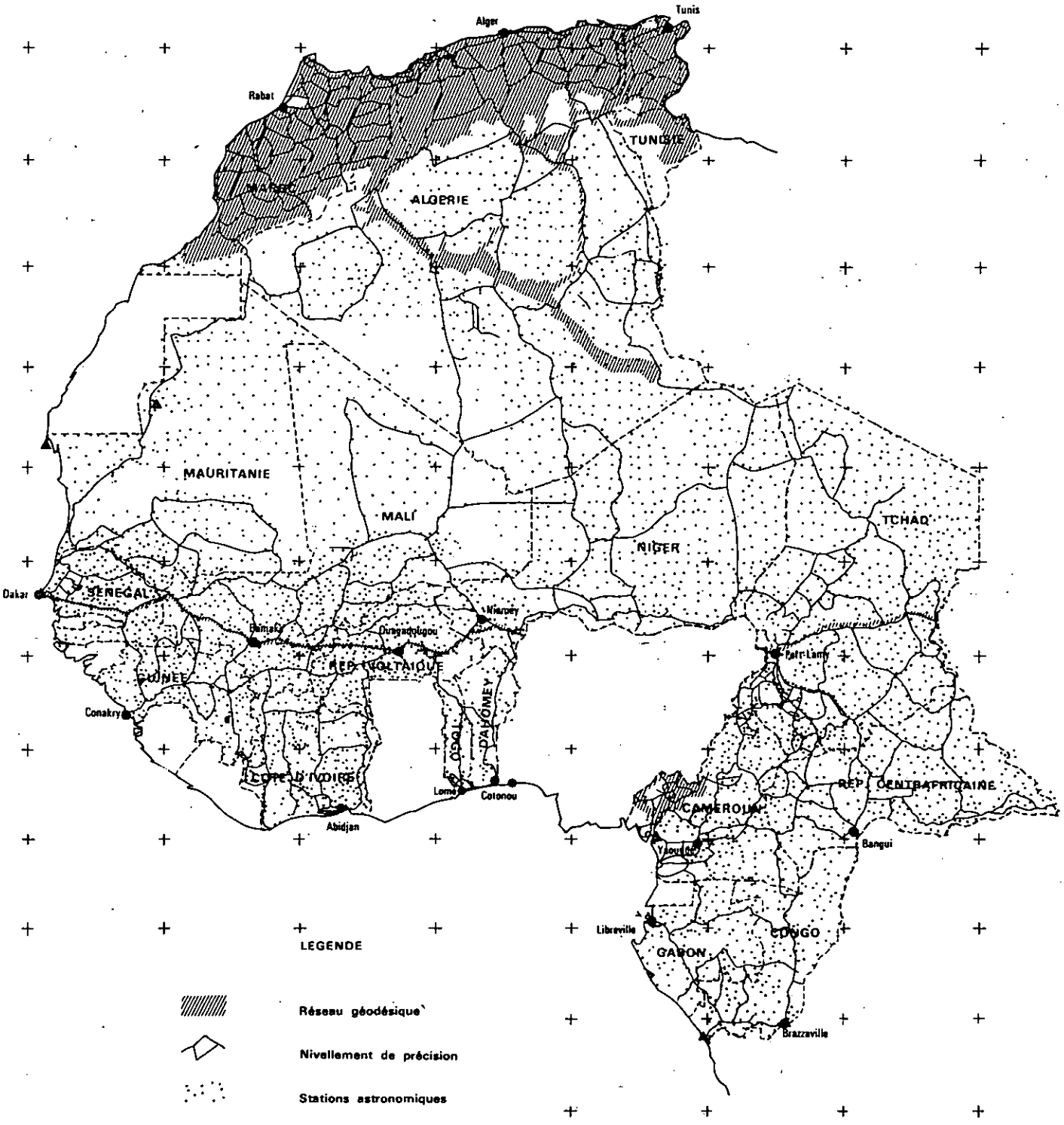
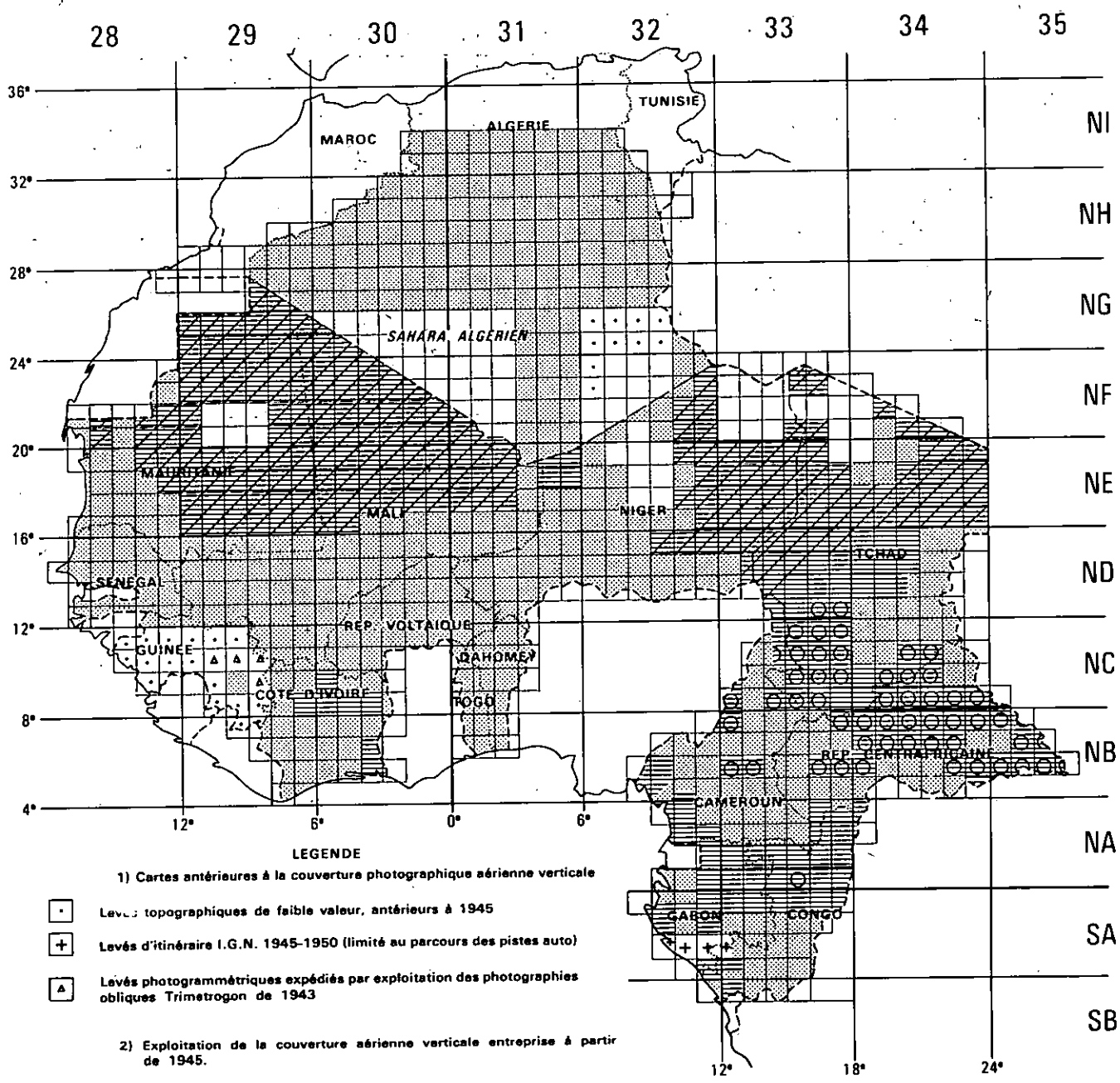



Fig. 4 — L'équipement de base - Situation en 1971.




LEGENDE

1) Cartes antérieures à la couverture photographique aérienne verticale

- Levés topographiques de faible valeur, antérieurs à 1945
- Levés d'itinéraire I.G.N. 1945-1950 (limité au parcours des pistes auto)
- Levés photogrammétriques expédiés par exploitation des photographies obliques Trimetrogon de 1943

2) Exploitation de la couverture aérienne verticale entreprise à partir de 1945.

- Fond planimétrique sans représentation du relief
- Représentation schématique du relief par des courbes figuratives non cotées
- Cartes des régions sahéliennes et désertiques. Représentation schématique du relief par des signes et des teintes traduisant les traits principaux de la géomorphologie
- Cartes régulières et semi-régulières

Nota : les chiffres et groupes de lettres placés en marge désignent les feuilles de la carte internationale du monde à 1 : 1 000 000 (Exemple : ND 30)

Chaque feuille à 1 : 1 000 000 est divisée en 24 feuilles à 1 : 200 000, selon les schémas ci-dessous :

| | | | | | |
|---|---|---|---|---|---|
| XIX | XX | XXI | XXII | XXIII | XXIV |
| XIII | XIV | XV | XVI | XVII | XVIII |
| VII | VIII | IX | X | XI | XII |
| I | II | III | IV | V | VI |

Fig. 5 — La cartographie au 1 : 200 000 établie par l'I.G.N. Etat d'avancement au 1er juillet 1972.

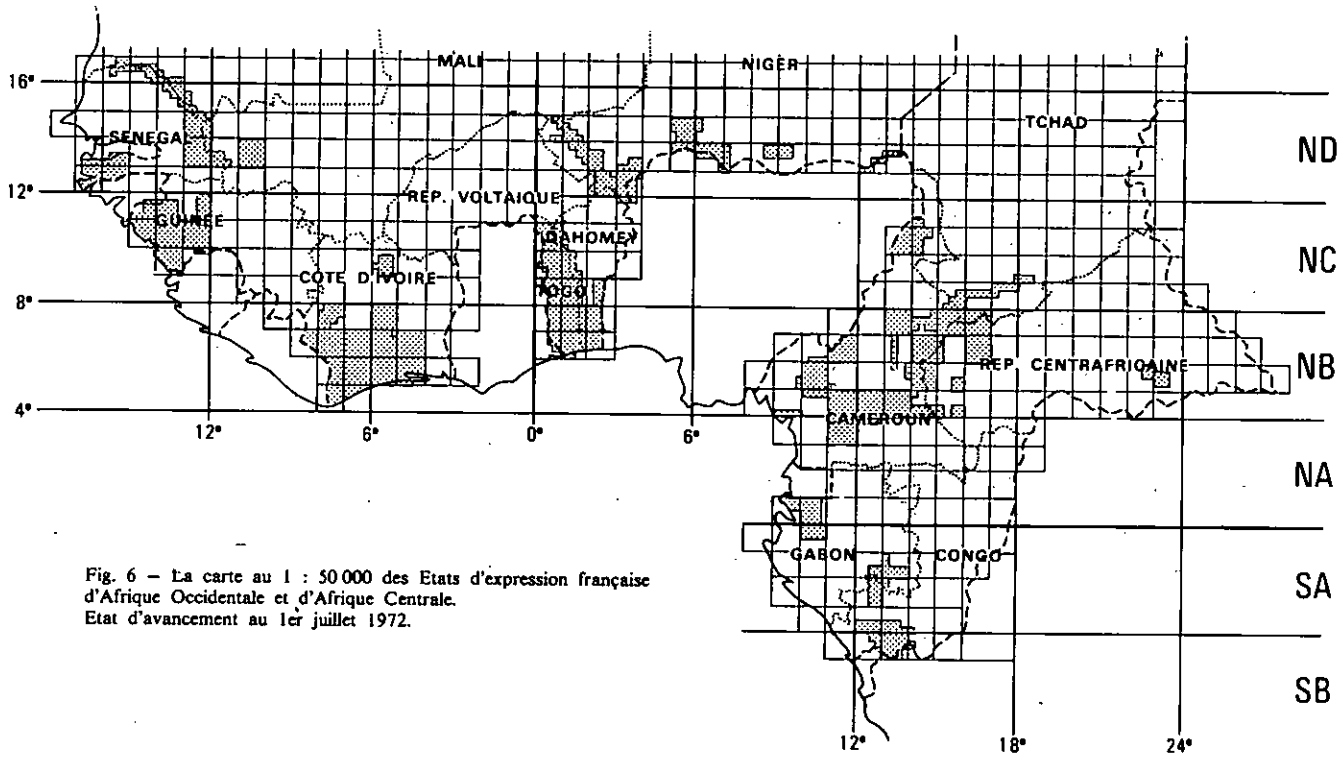



Fig. 6 – La carte au 1 : 50 000 des Etats d'expression française d'Afrique Occidentale et d'Afrique Centrale.
Etat d'avancement au 1er juillet 1972.

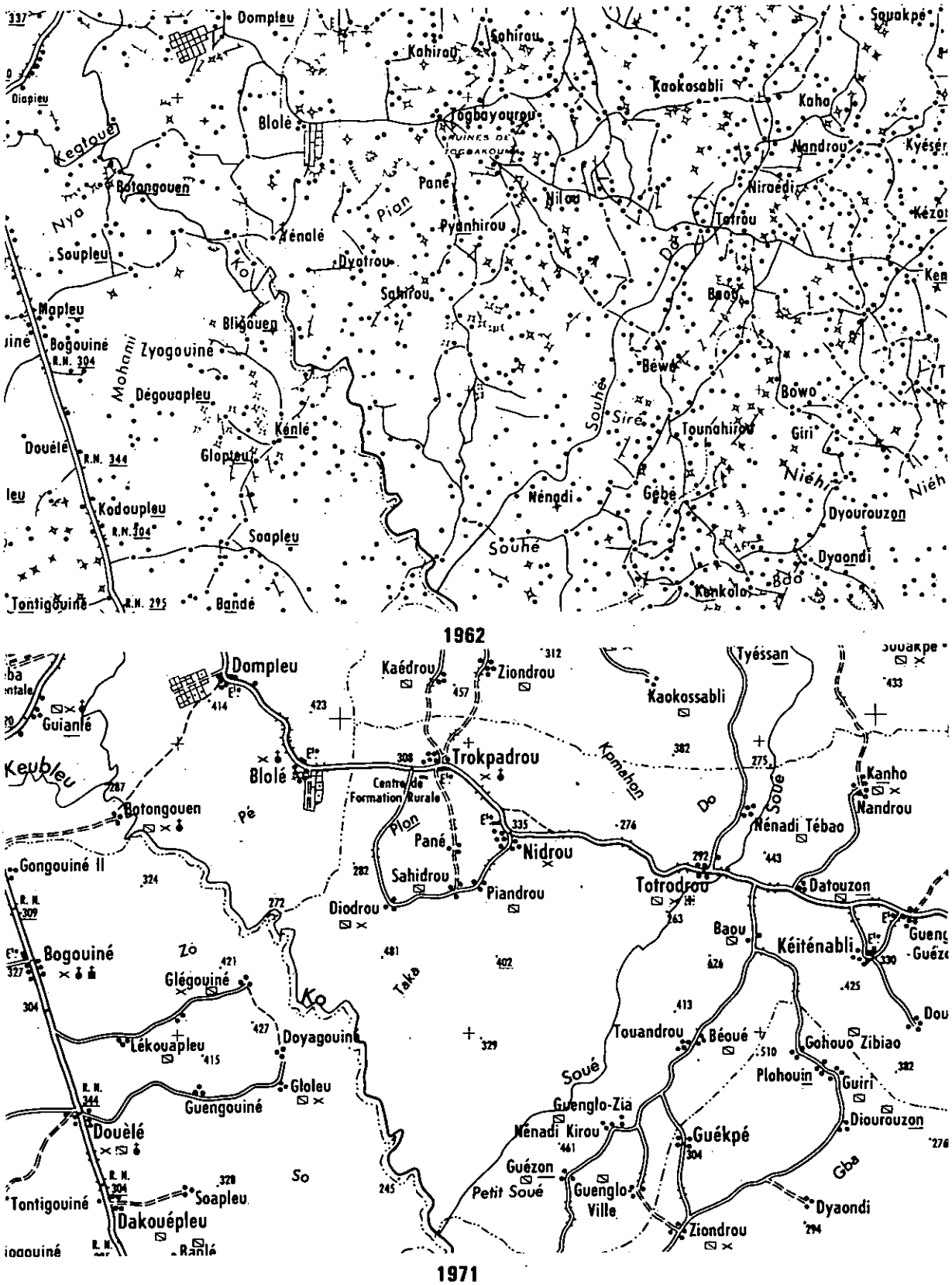



Fig. 7 — Extraits des éditions 1962 et 1971 de la feuille au 1 : 200 000 de Man (Côte d'Ivoire), mettant en évidence la nécessité d'une mise à jour régulière des cartes. Dans cet intervalle de 10 ans, le réseau routier s'est considérablement développé. L'habitat dispersé tend à disparaître, la population se regroupant dans les agglomérations situées le long des routes.