AFRICA

plans ahead

by

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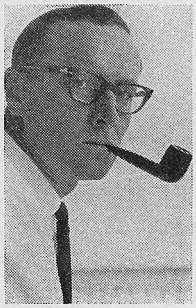

A. William BOYLE

On Monday 29 April at the ITU headquarters in Geneva, a very important conference began—the VHF/UHF African Broadcasting Conference. The African continent was well represented with 32 delegations. In addition France, Italy and Spain were represented as was the European Broadcasting Union (EBU), the International Radio and Television Organization (OIRT), the Union of African National Sound Broadcasting and Television Organizations (URTNA), the African and Malagasy Telecommunications Union (UAMPT), the United Nations (UN) and the United Nations Educational, Scientific and Cultural Organization (Unesco). The Conference opened with addresses by Mr. Gerald C. Gross, Secretary-General of the International Telecommunication Union (ITU), Mr. John H. Gayer, Chairman of the International Frequency Registration Board (IFRB) and Mr. L. W. Hayes, Adviser to the Director of the International Radio Consultative Committee (CCIR), in which co-operation and assistance from the Union headquarters was offered. This opening session elected Mr. Alpha Diallo, Director-General of Information in the Ministry of Information and Telecommunications of the Republic of Guinea, and President of the URTNA, as its Chairman by acclamation. Mr. Gabriel Tedros, Regional Manager and Technical Inspector, Imperial Board of Telecommunications of Ethiopia, and Chairman of the 18th session of the ITU Administrative Council, 1963, was elected as its Vice-Chairman.

As the European counterpart of this Conference was only held very recently—in Stockholm in 1961—it was interesting that Africa should act so soon afterwards. However, the success of the African Conference completely justified this timing.

This Conference posed a whole new series of problems related to planning and operation of VHF/UHF broadcasting services on a continental scale. It was the means of arriving at a comprehensive, flexible and sound technical frequency plan for the development of future VHF/UHF broadcasting services throughout the African continent. The Conference was to arrive at a *general solution* of a complex problem so that later developments would enable *particular solutions* to be found from the general solution.

The African nations had observed the problems arising in other parts of the world due to lack of co-ordination at early stages, and resolved that this was not to be the case for Africa. Of the 35 Administrations involved, 32 were present, and the frequency assignments were proposed for the absent three. The countries co-

operated in furnishing the necessary preliminary information.

The technical basis for the Plan had been foreseen as a difficulty at an early stage, so an extensive programme of investigation had been completed. The CCIR provided an assessment of propagation conditions for the continent with sub-divisions on a climatic basis (see Figure 1)

In view of previous planning of television stations in different parts of the world, it could be thought that this African Conference would not be breaking new ground. This is far from true. None of the propagation data used previously, for instance at Stockholm, referred to tropical and sub-tropical conditions. Propagation phenomena in some parts of the world are very accurately known, whereas little comparable information existed for Africa. The Stockholm Conference had to a large extent to deal with a *fait accompli* before planning for the future, as very extensive development had already occurred in bands I, II and III, and to a lesser extent in bands IV and V. On the other hand, although in Africa television services had already been put in operation, it was at a fortunate stage where this development could still be incorporated into the Plan based on an overall pattern. Africa is very much in the process of widespread development; therefore, the Plan for Africa must be flexible to allow for future population and economic development in regions that could not yet be foreseen.

Technical

Initial sessions of the Conference dealt with the technical basis for planning. Propagation curves, protection ratios, and theoretical lattices for channel distribution were adopted. The theoretical lattice is a device intended to enable planning engineers to allocate available channels to broadcasting stations in a region in such a way as to provide maximum density of stations on a logical repetitive basis. A direct method of planning through the consideration of appropriate limiting distances was adopted for band I. Bands I and III were to be planned for 7 Mc/s and 8 Mc/s channels as decided by each country. Bands IV and V were agreed to be planned for 8 Mc/s channels as in the Stockholm Plan. The 625-line television standard was adopted. Different systems using the same channel spacing were to use the same relative frequency for the vision carrier. The sound carrier is to be always at a higher frequency than its associated vision carrier, and the vision/sound power ratio is to be 5:1. Frequency modulation is to be used for sound, and picture modulation is to be negative. The future introduction of colour television was considered. The frequency of any colour sub-carrier is to be the video carrier frequency plus 4.43 Mc/s.

For band II, FM sound broadcasting, the following standards were adopted: maximum frequency deviation ± 75 kc/s, pre-emphasis 50 μs, and receiver intermediate frequency 10.7 Mc/s.

The uncertainty of the ultimate broadcasting requirements of Africa, instead of complicating the problem, actually permitted the Conference to tackle the problem first from the theoretical point of view and to use lattices. If stations and channel arrangements already exist in the area, their incorporation into the lattice pattern is essential but can be very tedious. As most of Africa did not have any existing services, the standard theoretical lattices were applied on a large scale; Figures 4 and 5 show a lattice applied to the continent. This Conference certainly used continuous lattices on the widest scale to date. As band I (41-68 Mc/s) contains very few channels (three at 8 Mc/s or four at 7 Mc/s) the main manipulation advantage of the theoretical lattice did not apply. Band I is also distinguished from the other bands by the fact that intermittent very-long-distance propagation is to be expected by means of the spread F and the Es layers of the ionosphere. Therefore long-distance interference can occur over ranges of more than 2000 km. For this reason some African Administrations resolved not to use this band at all. It was also realized that Administrations intending to exploit this band will require close co-ordination with other users.

Another problem existed in Africa since fixed point-to-point services and radionavigation already occupied frequencies in band III. After considering all the factors involved, and allowing for the belief that these other services should ultimately disappear from this part of the spectrum, these were considered in planning for the sake of reality. The point-to-point services were the most serious problem; bandwidths up to almost one megacycle are used, transmitter powers are low, received field strengths are not great and antenna directivity is reduced by the multipath effects of television interference. There-

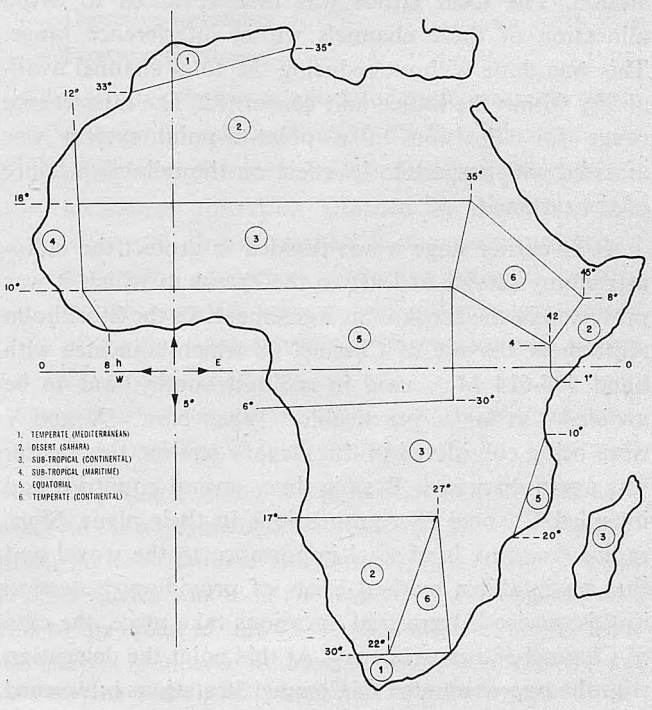

Figure 1. — Propagation conditions on a climatic basis

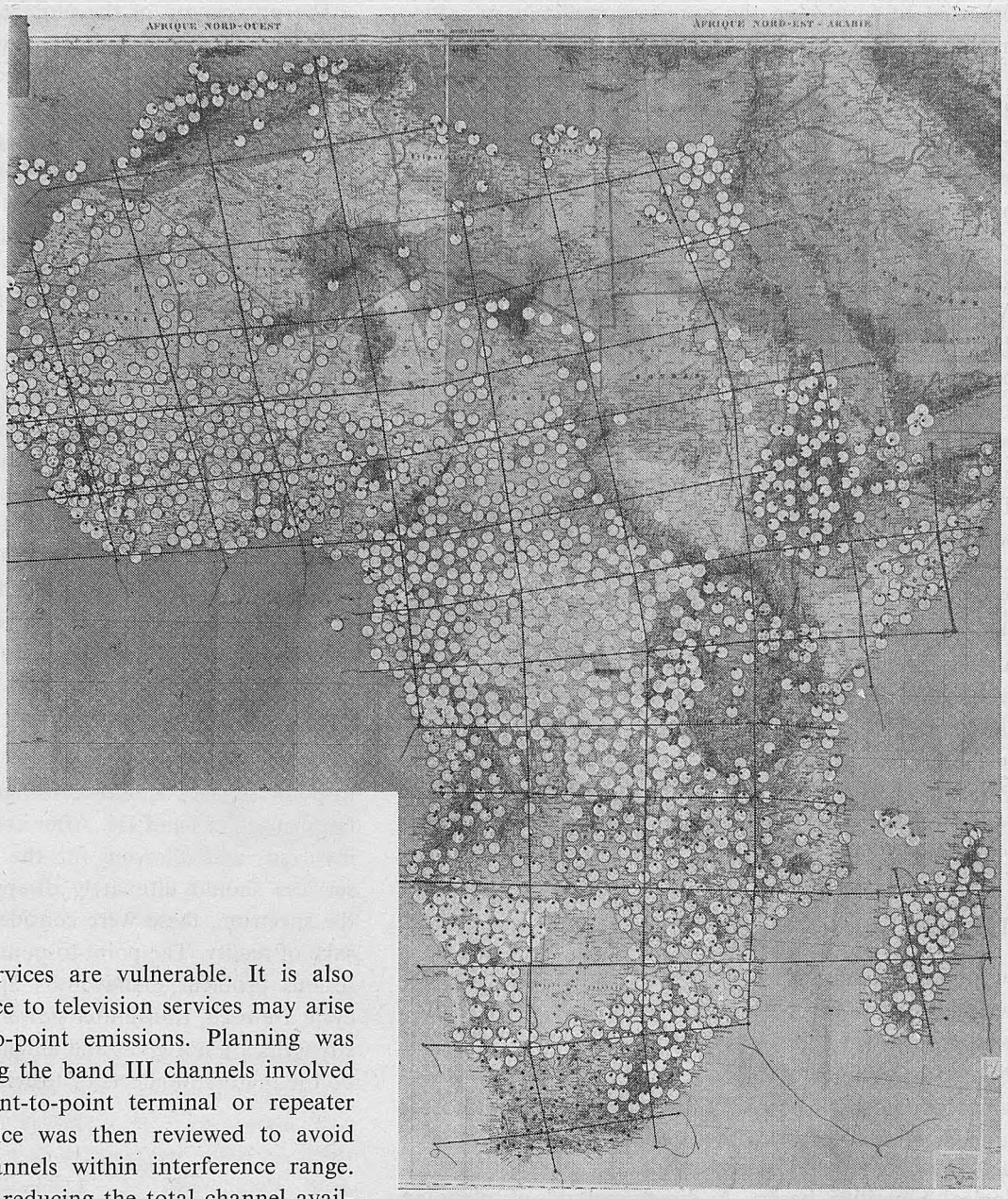

Figure 2. – Band II : Channel allocations and lattice.

fore, point-to-point services are vulnerable. It is also possible that interference to television services may arise as a result of point-to-point emissions. Planning was directed toward defining the band III channels involved in each case of a point-to-point terminal or repeater station. The local lattice was then reviewed to avoid allocation of these channels within interference range. This was done without reducing the total channel availability within the lattice unit concerned. The interference range for television to a point-to-point system was assessed with respect to its effect on the reliability figure of the system.

At an earlier stage it was decided to protect the radioastronomy service at least to the extent to which it was protected in the Stockholm Agreement. In the Stockholm Agreement the use of Channel 38 which coincides with band 606-614 Mc/s used in radioastronomy, was to be avoided " as far as practicable." When bands IV and V were being considered in the Plenary session, this matter was again discussed. By this time, several countries had included Channel 38 transmissions in their plans. Since radioastronomy is of vital importance to the world and that no infallible method exists of providing protection in this service if terrestrial emissions take place, the case of Channel 38 was reopened. At this point the delegation with the largest number of Channel 38 stations intervened and announced a dramatic modification—their deletion of all proposed use of Channel 38. This action was greeted with spontaneous acclamation, as was the announcement by successive delegations that Channel 38 would not be used for television. This is timely and significant in view of the October ITU Space Conference which will, in addition to allocations for space, consider the requirements of radioastronomy.

As the Conference had agreed on the use in practice of 7 Mc/s and 8 Mc/s channels for bands I and III, and for 8 Mc/s channels for bands IV and V, the matter of protection ratios was complex, and had to be determined in detail. In addition to this, two main systems were envisaged for use with the 8 Mc/s channels. These two systems are the K* and the I, which have identical vision carriers in all channels, but the sound carriers differ by 0.5 Mc/s.

Planning

In all bands including band II, 10 604 stations were planned for Africa. The calculation of probable interference fields—on which the planned effective radiated powers were to be based—would have been impossible by manual means at least within any practical time limit. The IFRB computer was employed for this work, and its unique contribution to this Conference will be the subject of the second and concluding article on the Conference.

The extent of the final Plan is:

Band I	129 stations
Band II	4969 stations
Band III	1082 stations
Bands IV & V	4424 stations

These four band groups were planned separately on ndividual large-scale maps of Africa; band II is shown in Figure 2.

Requirements had been sent to the IFRB by the African countries before the Conference. These station locations were then shown on the large-scale maps by coloured pins, the colour code indicated the power order of the transmitter. No reference was made at this time to channels. Planning for bands I and III, band II, and bands IV and V was done in separate rooms at the ITU headquarters, where the delegates met to discuss and negotiate the arrangement of specific channels.

After the protection ratios, propagation curves and the theoretical lattice for each band had been adopted by the Conference, the lattices were transferred on to the maps for bands II, III, IV and V. These lattices were arranged to coincide with the limits (30° North) of the relevant theoretical lattices used for Europe at the Stockholm Conference. This was decided so that the African countries already partly included in the Stockholm Plan, for instance, the Democratic and Popular Republic of Algeria and the United Arab Republic, which lie above and below 30° North (also the geographical limit of the African Plan) would be covered by a continuous lattice.

The Conference decided to consider the bands in the following order: *bands I and III*; *band II*; *bands IV and V*, to facilitate access to the maps. For planning purposes the Conference also sub-divided Africa into three regions: east, south and west. The work was then organized so that all three regions could be planned simultaneously on a different group of bands.

When the lattices were applied, it became apparent that some station rearrangement would improve the Plan. At the same time, a better coverage was provided. Channel allocations were then made without offset or orthogonal polarization.

When this first detailed layout had been complete for each region, the maps of the three regions were assembled and boundary allocations revised to fit an overall layout. Then the tentative power (erp) of each station was allotted. At this stage of planning, interference calculations were necessary, and the channel arrangement and the proposed power of the station for bands I and III, band II, and bands IV and V were fed into the computer.

While this had been going on, the large-scale band maps had been kept up-to-date with all changes. At this stage stations were shown with the proposed channel allocations by means of numbered pins for the television bands and channel indicator discs for band II. As two basic television systems were involved in bands I and III, the numbered pins for these maps were of two colour series to indicate whether a 7 or 8 Mc/s system was concerned.

As the first stage of planning for bands IV and V ended, the computer calculations of interference for band I and band III were made available. This was stage two of planning, in which the probable interference between the tentative stations was calculated on the basis of the propagation curves for the various climatic regions of Africa. The presence of two different bandwidth systems in bands I and III complicated the calculations as receiver discriminations varied according to frequency displacement.

In general no interference fields were acceptable beyond the protection ratio limits. Those cases that were included in the Plan not meeting this condition had been individually considered by the delegations concerned and found to be satisfactorily protected due to local conditions, for instance, mountain barriers.

Steps taken by the delegations to reduce interference according to the advice of the IFRB were:

- Polarization
- Frequency offset
- Directive antennas
- Power reduction

Conservative figures adopted for these measures were:

- orthogonal polarization: 10 db discrimination
- offset of eight twelfths of the line frequency: 15 db
- maximum protection afforded by directional antenna: 20 db with respect to the maximum erp of the station concerned. (Directive antennas for protection purposes were viewed with caution because of the fact that conditions in practice may reduce the directivity effect)
- grades of service, A=70% and B=50% of locations each for 99% of the time.

At this stage, many delegates negotiated with each other on the adjustment of channels and station characteristics. As international interference was concerned, the IFRB's advice was most welcome in these negotiations. It is to the credit of this Conference that not one of these discussions foundered in discord. Reasonable and mutual concessions were made and each case was accordingly solved. In several instances, delegates deleted a seriously

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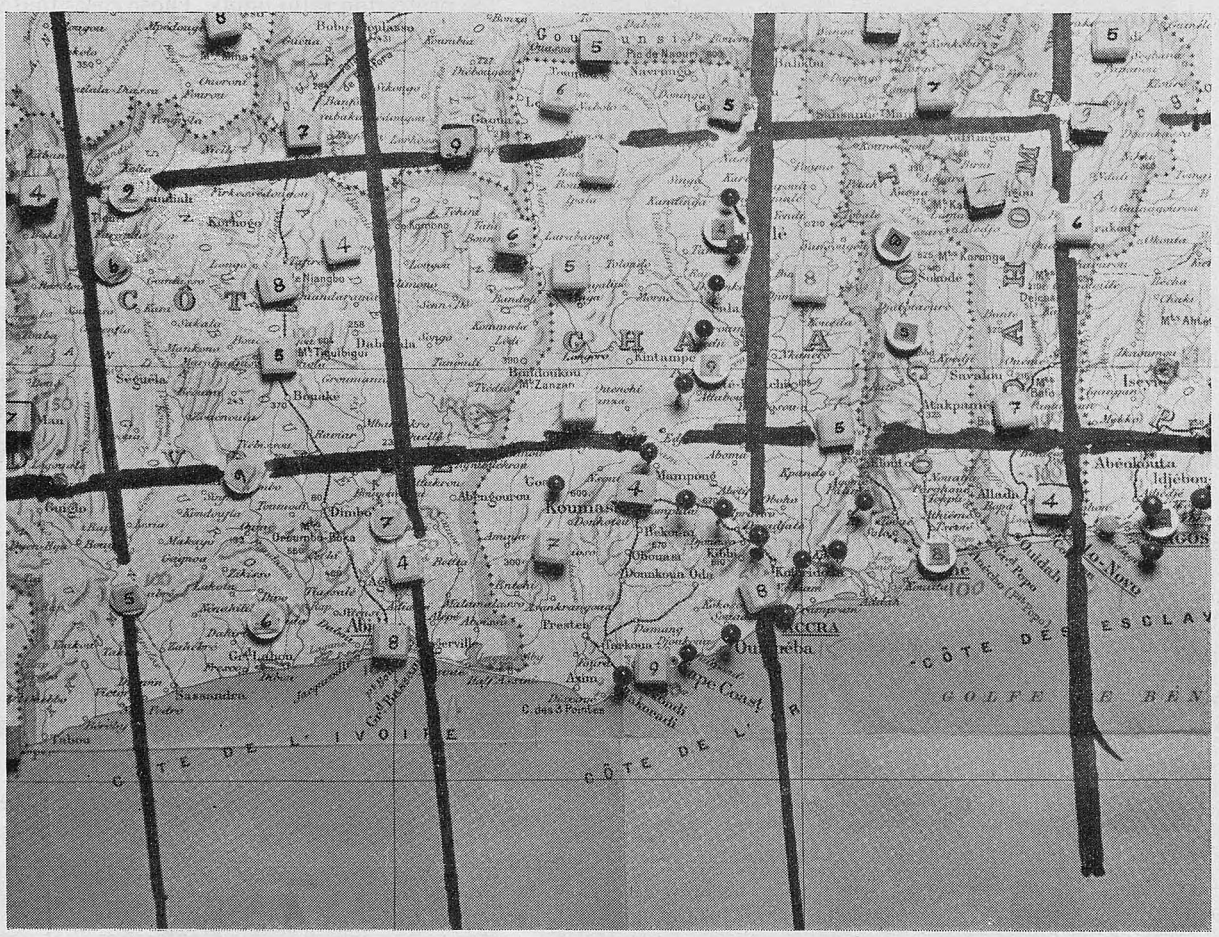
Figure 3
In this group, the Conference Vice-Chairman discusses band III with the Liberian Delegation

Figure 4
Enlargement from Figure 5 showing channe numbers and Fixed Service stations



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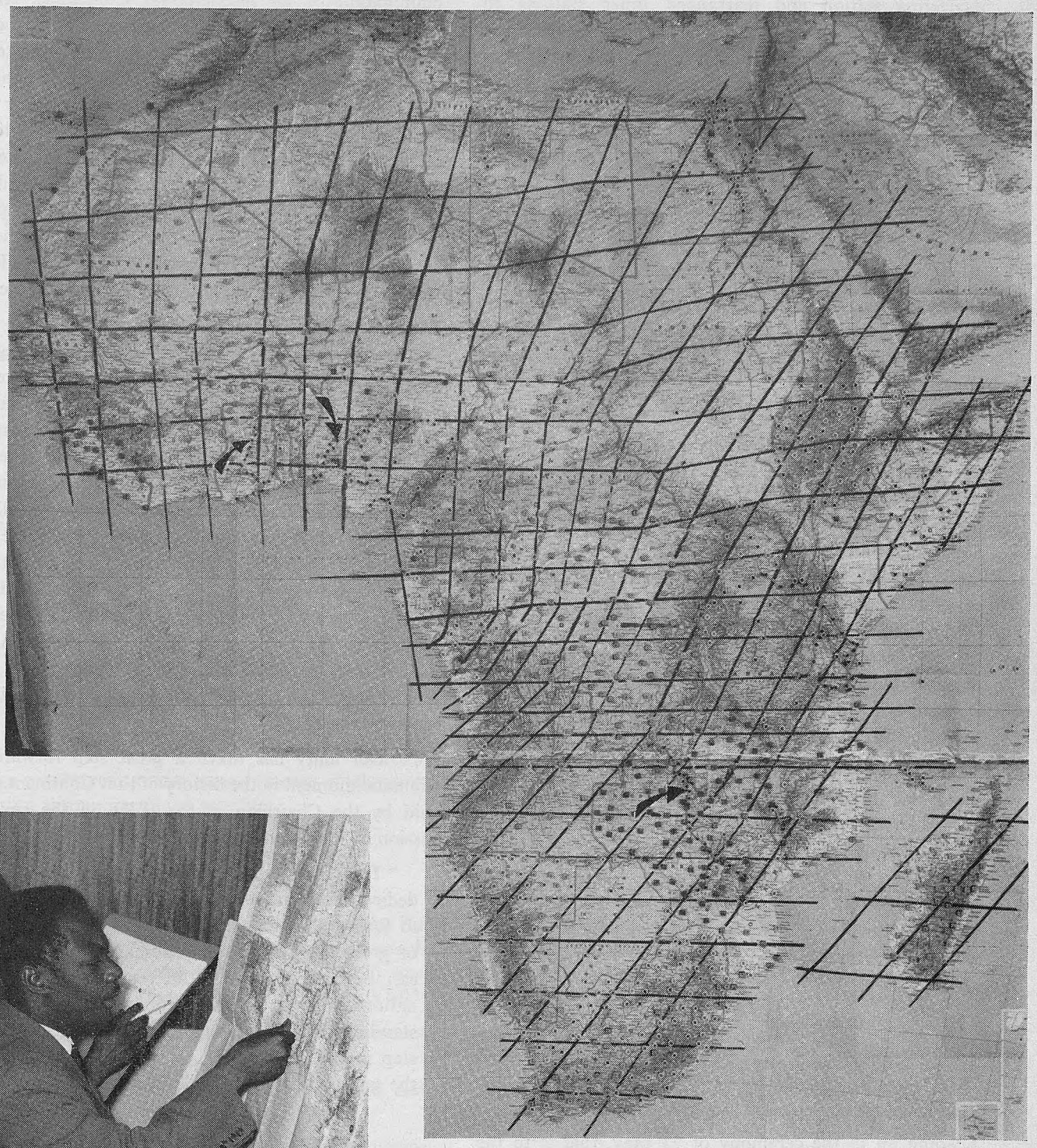

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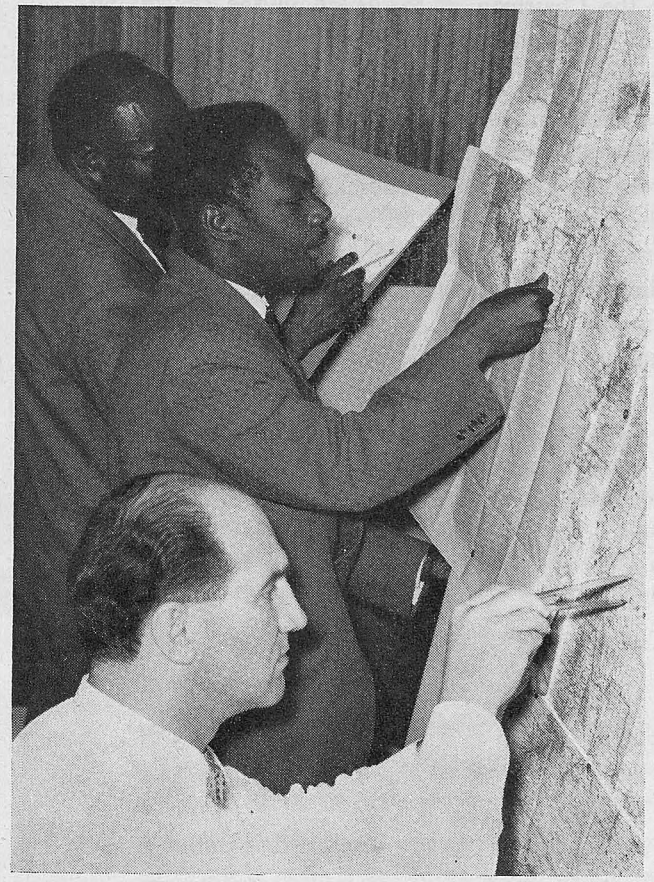

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Figure 5
Band III: Channel allocations and lattice

Figure 6
Planning band 1

interfering station and rearranged other stations to obtain the necessary coverage. Those delegates with fixed services in band III found their neighbours prepared to be co-operative, and as a result comprehensive broadcast coverage was provided that would not affect the operation of the point-to-point services. Service area limits were arranged to be compatible with national boundaries. Existing transmitters were taken into account, and when it was determined that interference would be likely, channels were rearranged.

The most protracted negotiations took place in the band III room. In band I requirements were not so great as previously explained. For bands II, IV and V many more channels are available and the problems were not therefore so acute.

After decisions had been taken on the band I and III stations, the computer was again used to calculate the new interference pattern, that is after adjustment of channel assignments and the addition of orthogonal polarization and frequency offset to reduce interference. So that a comprehensive Plan could be evolved, delegations had taken advantage of the availability of the computer calculations to completely review their networks, and not merely review the frontier interference cases. In the preliminary interference investigations alone, the machine calculated more than ten million individual cases of the probable interference between two channel assignments.

After the final print-outs of the calculations in al bands had been analysed and the necessary adjustments and rearrangements were made, the Channel Plan of stations was considered by the Plenary Session of the Conference. Each frequency assignment was examined in turn, corrections made, and new lists issued, until at last on Thursday, 23 May, at the third reading, the Plans were adopted.

The Agreement is signed

That evening, at a ceremony in the Council Chamber of the ITU, the delegates of the Administrations of Africa met in final Plenary Session to sign the Agreement. Leading up to the ceremony of 23 May, that is to the culmination of an international Conference which is distinguished not only by its unanimity of purpose but also by the fact that it ended before its projected conclusion date and cost less than the budget estimate, was the remarkable tempo of work maintained for nearly four weeks. Delegates were ready and willing to work at weekends and at night, and the ITU headquarters staff made good the promise made in the opening address to the Conference on 29 April, that everything possible would be done to assist. As one delegate was heard to say when he left at 3 a.m. one morning, the IFRB was still there and when he returned at 8 a.m., the IFRB was there already—or had not left at all.

The effort put into this Conference by the delegates of Africa and by the ITU has produced a notable Agreement. Not one reservation was made. The Plan has been prepared at a sufficiently early stage for it to be important in making it possible to have an orderly and effective growth of television and FM sound broadcasting. The problem of continental-scale planning was realistically considered and the Plan is sufficiently flexible to be adapted to almost any development pattern that may occur; at the same time, it lays down lines for development that are logical and clear. The Plan is one of the annexes to the Agreement. In the Agreement, Article 3 sets forth a straightforward procedure, valid for all bands, according to which the Plan can be modified to meet changes.

African unity has taken a great step forward, at a dramatic moment in the history of that Continent. As was said by the Chairman of the IFRB in the concluding session of the Conference,

> " This Plan is a triumph of sheer hard work, of dedication to an ideal. It will surely become an example to future planners. It stands as an example not only of great technical accomplishment, but also of what can be achieved when the representatives of many nations work together with goodwill and mutual understanding. The success of this Conference is a major step in the development of world communications—the goal of our great Union."

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