HYDROGRAPHIC SURVEY OF SURINAM

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Lecture given during the 9th International Hydrographic Conference

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When the request came from the IHB as to whether we wished to give a lecture during the 9th International Hydrographic Conference I suggested that we might say something about the hydrographic survey being carried out in Surinam, and more especially how the survey control — i.e. the position-fixing — is being carried out. Our Hydrographer then asked me to give this lecture. I have had no experience at all in giving lectures in the English language, or to such a highly qualified audience, so it was with much reluctance that I accepted the task.

Figure 1 shows the Dutch nautical chart of Surinam, a former Dutch colony situated in the North East of the South American continent.

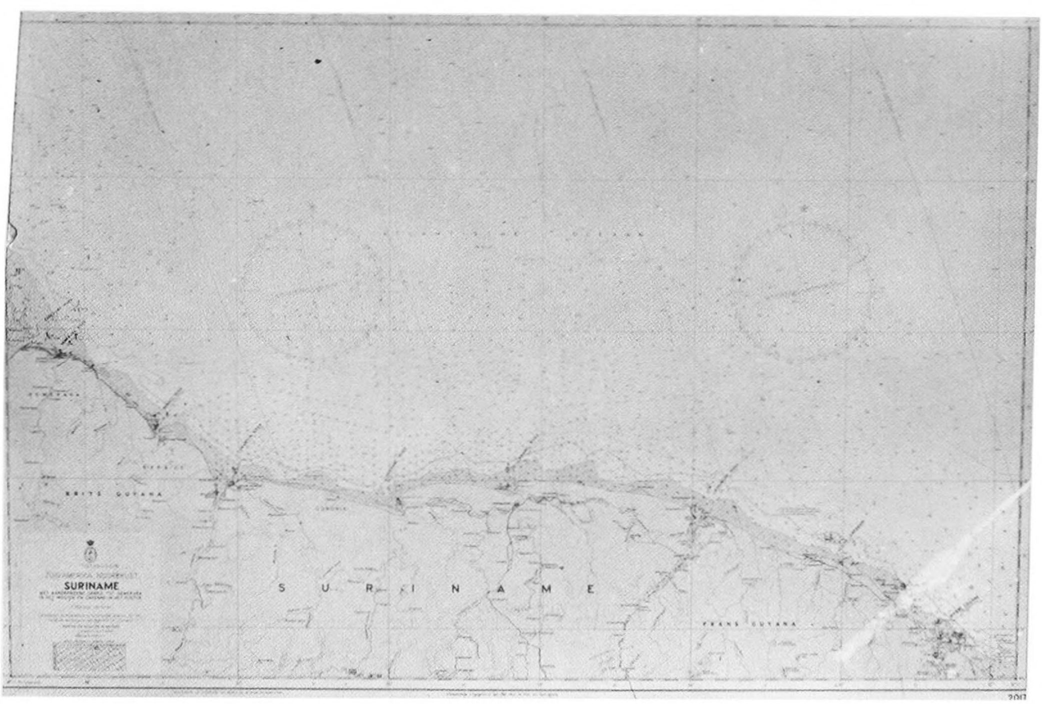

FIG. 1

The hydrographic survey is being carried out at the request of the Government of Surinam who consider that accurate charts are indispensable for the further development of the country.

Topographically, the country had been charted recently by means of photogrammetry, terrestrial control being based on astro-stations.

Hydrographically, the continental shelf had been surveyed in 1927, but that survey should be considered as an open survey.

The entrances to the rivers — the Surinam and Cottica, as well as the Corantine and Nickerie rivers — had been frequently re-surveyed by the personnel of the Harbourmaster at Paramaribo, the capital of the country. During the past few years, however, these surveys have become more infrequent on account of lack of trained personnel.

The conventional method of survey control by means of shore-beacons had to be discarded on account of terrain conditions and the extent of the off-shore area to be surveyed, i.e. up to about 100 miles from the coast.

Since we possessed equipment for a hyperbolic Decca survey chain that had already been used in the former Netherlands colony of New Guinea it was logical that this system should be brought into operation again for Surinam. Because, as I have just mentioned, reasonable topographic

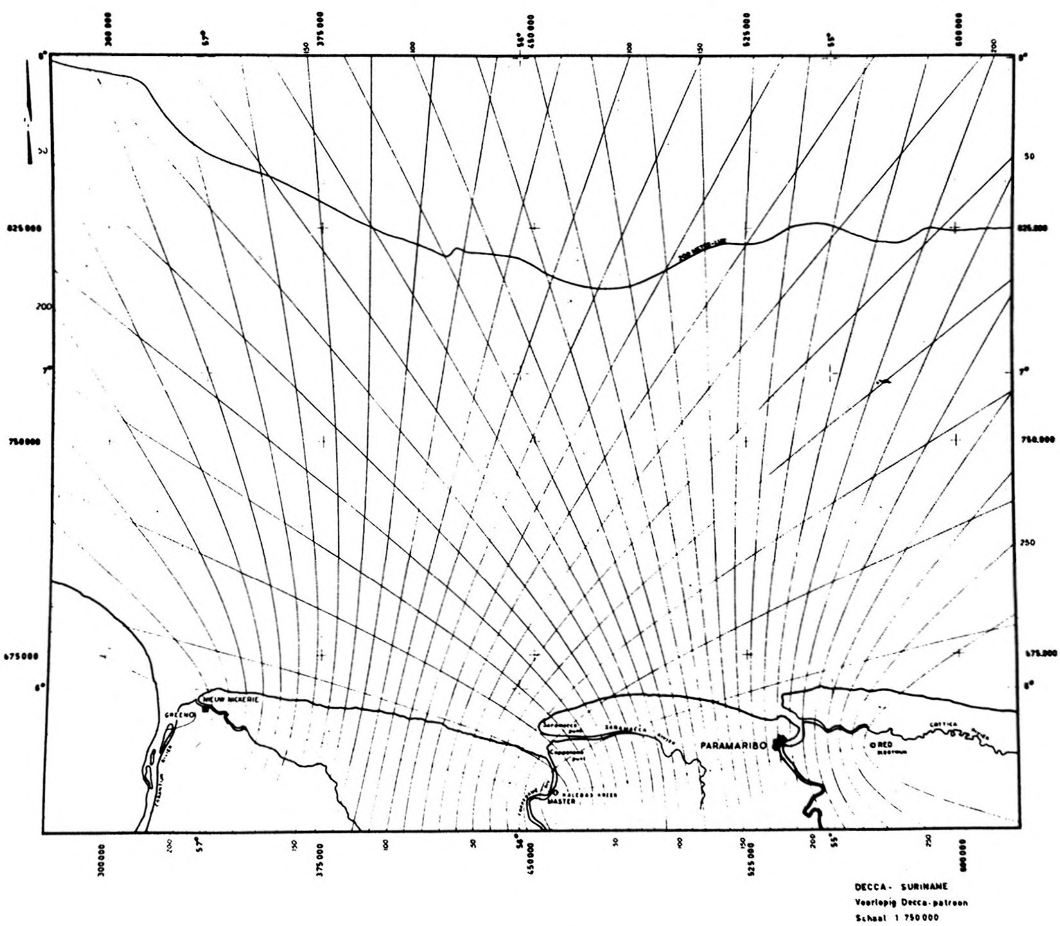

FIG. 2

mapping already existed, the sites of the Decca stations could be selected beforehand.

The chain could have been set up to cover the whole area to be surveyed but that would have meant positioning the Master station rather far inland. To avoid long land-paths a set-up in two stages was therefore chosen : firstly to cover the western part of the area, and then to shift the stations to cover the eastern part.

The existence of a Netherlands Army unit in Surinam was of great help for logistic support. Moreover, the building of the stations could be left to the Army's Corps of Engineers.

A road connecting New Nickerie in the West with Albina in the East of the country solved the problem of transport of equipment and personnel.

After a two week visit paid to Surinam by our Hydrographer and our Decca expert, Lt. Cdr. DON, to examine the situation on the spot and to have preliminary talks with the officer commanding the Army force and the Surinam Government a plan was drawn up for establishing the chain.

The whole affair was scheduled to take eight weeks. The pre-fabricated bungalows available in Surinam for the Decca Company's personnel and the foundations for the generators were both built before the arrival of the equipment. The equipment for the chain arrived in Paramaribo in mid-December 1965. The chain itself became operational by the end of February 1966 which was exactly according to schedule.

The survey had to start immediately after the chain came into operation and because we had agreed that the Dutch survey vessel H. Neth. M.S. *Snellius* would survey part of the entrance to the Corantine river in company with the British survey vessel *Vidal*, hyperbolic plotting sheets had to be available at that moment. *Vidal* was using the Decca Lambda system, with the two Slave stations situated in British Guyana. A Decca receiver of the Surinam chain was loaned to *Vidal* so that comparison of the two systems could lead at a later stage to some sort of adjustment of the two surveys which were based on different triangulation systems.

These preliminary plotting sheets were computed and " automatically " drawn, using the assumed positions of the Decca stations, the assumed propagation speeds, and the baselengths derived from the positions of the Decca transmitters.

After lane-counting carried out on board a chartered aeroplane it was possible to make a better approximation of the chain constants, and with these new constants new preliminary plotting sheets were then computed and drawn.

Figure 3 shows a diagram of free air gravity anomalies in the area in question. These anomalies were worked out by the Geodetic Laboratory at the Delft Institute of Technology from the recordings of a shipborne Askania gravimeter and gravity measurements on land carried out previously.

I may mention that before starting the hydrographic survey a six week geophysical, geological and biological survey had been carried out. A publication concerning this survey will shortly be issued by the Netherlands Hydrographic Office.

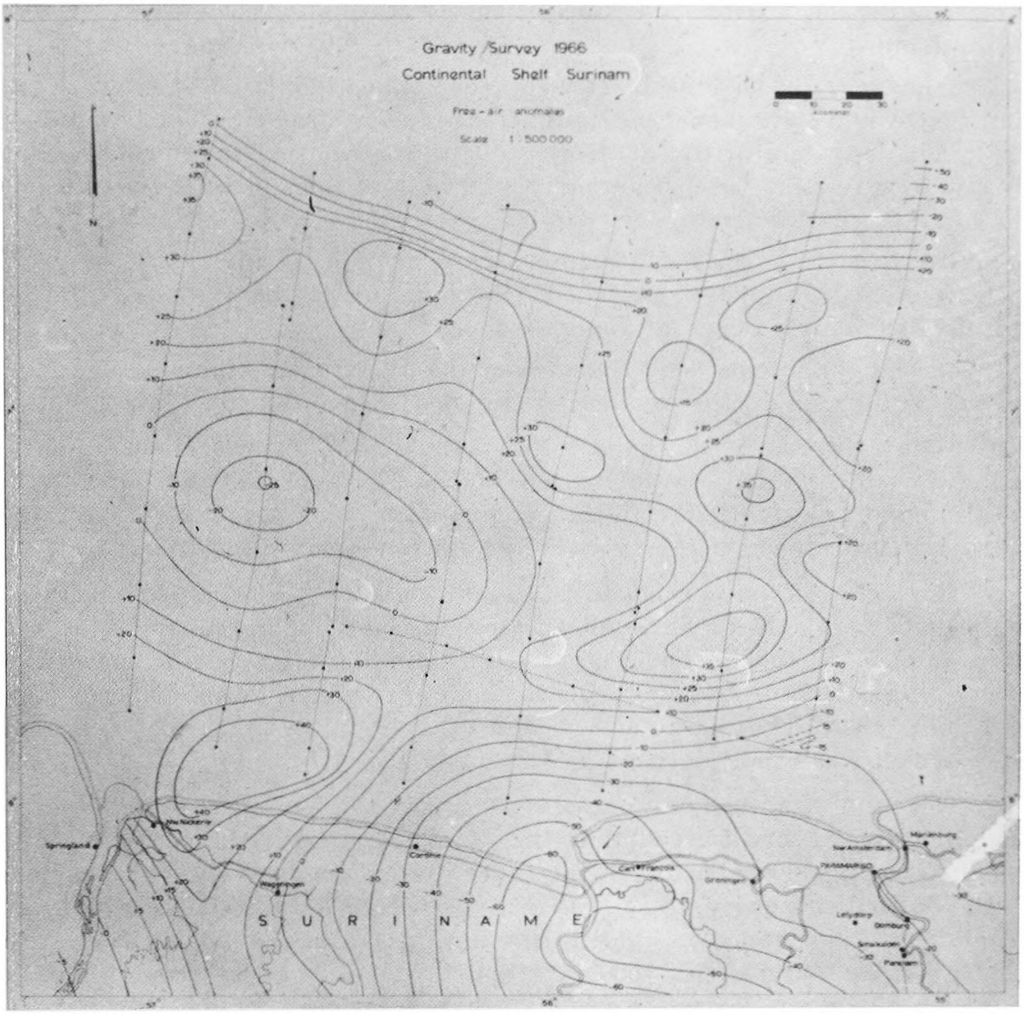

Fig. 3

From these free air anomalies (expressed in milligals) it was obvious that the astro-stations on which the Decca stations were based would be rather seriously affected by plumb line deflections, and this explained the discrepancies observed after lane-counting.

It was therefore considered necessary to measure the baseline accurately. This was done by a tellurometer traverse along the East-West road, in steps of about 1.5 kilometres (i.e. approximately one statute mile) — a traverse which has only recently been completed. Because of the existence of an American Hiran trilateration in South America — with Hiran stations in Guyana and in Surinam (near the airfield of Paramaribo) — the tellurometer traverse was connected to these Hiran stations. Consequently at a later stage the whole survey may be connected to the adjusted Hiran trilateration. A number of the original astro-stations have been connected to this traverse. It is intended to establish new astro-stations at one or two tellurometer traverse stations to check the plumbline deflections.

The task of computing the hyperbolae and drawing the plotting sheets has been carried out by the Geodetic Branch of the Rijkswaterstaat, which

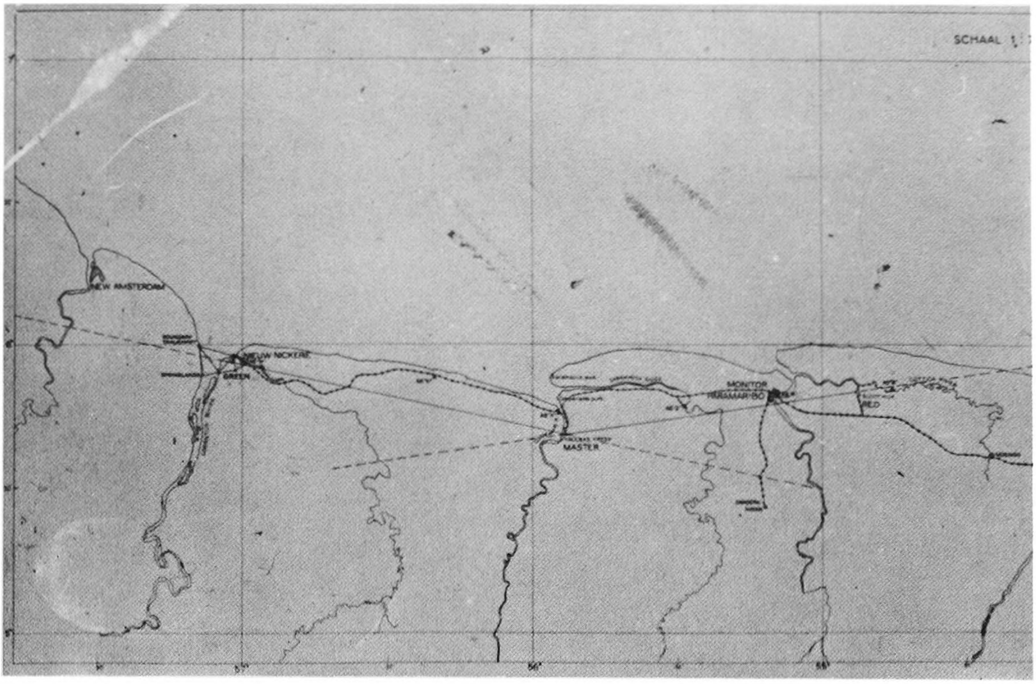

Fig. 4

is our Department of Public Works. This department is concerned with the defence of the Netherlands coasts against encroachment by water, and it carries out reclamation work, takes care of ports, inland waterways, roads and bridges, etc.

For its various projects, the Rijkswaterstaat has in operation a Decca hyperbolic survey chain in the South-West of the Netherlands, as well as some Decca Hi Fix chains, one at IJmuiden, one at the Hook of Holland and one in the North-East part of the Netherlands. This department is consequently familiar with the system and its problems.

The drawing of the preliminary sheets was carried out on time because that Department has a computer at its disposal on a part-time basis, and it has also recently obtained an electronic plotting and drawing machine.

It may be mentioned that the computer used is of Dutch manufacture, and is called ZEBRA; it was developed by the Post Telegraph and Telephone Service's laboratory. The word ZEBRA stands for *z*eer *e*envoudig *b*inair *r*eken*a*pparaat which means very simple binary computing apparatus.

The plotter used is an American one, trade mark Calcomp.

The following points are mentioned to give some idea of the techniques used in producing the hyperbolic plotting sheets.

A given plotting sheet's limit is intersected at a certain point by a certain hyperbola which means that the problem of finding the point of intersection of a straight line with a hyperbola has to be solved.

When this point has been determined a straight line is drawn by the drawing machine and this intersects the hyperbola at such a distance that

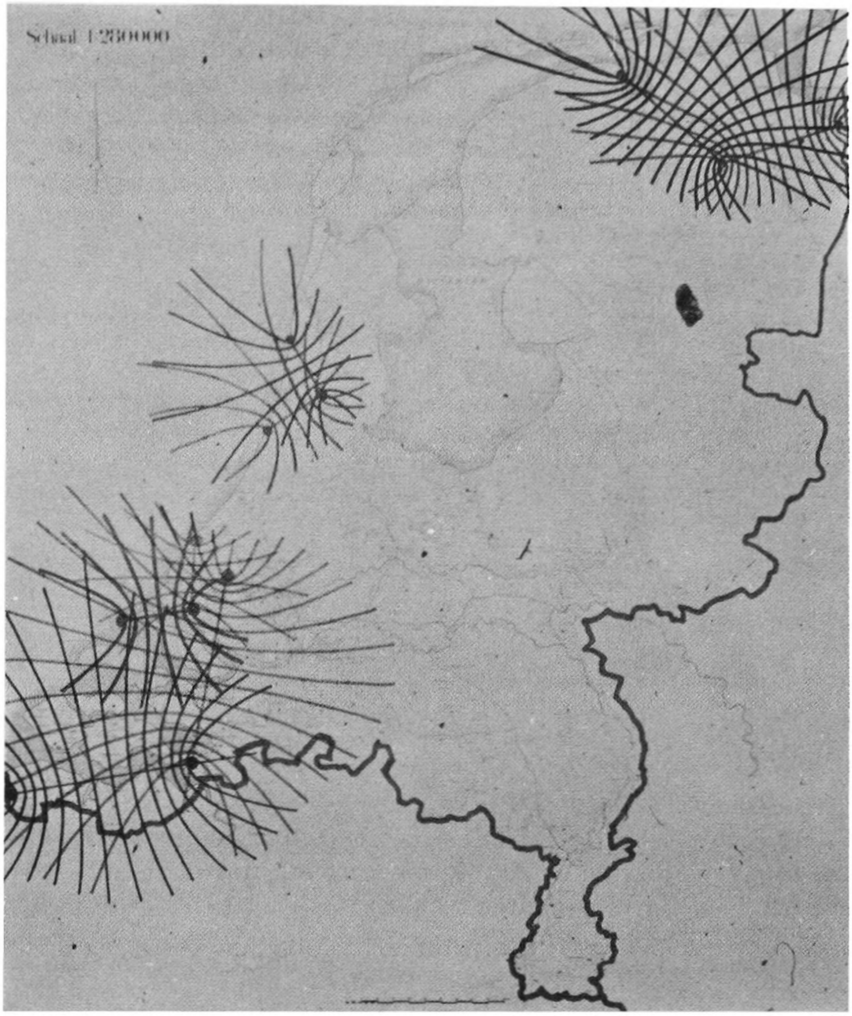

FIG. 5

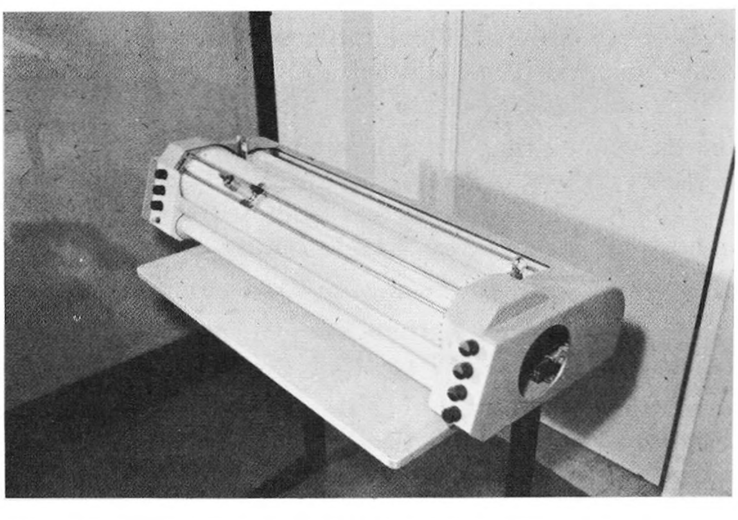

FIG. 6

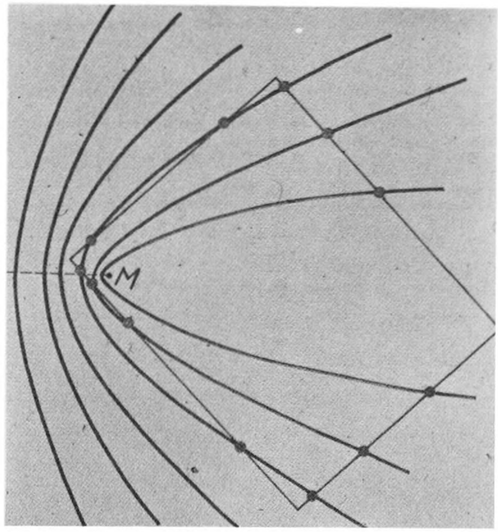

Fig. 7

the maximum distance between the actual hyperbola and the straight line constituting the chord will not be greater than 0.1 mm measured in the x or y direction, which means that the distance perpendicular to the chord will always be smaller. Thus the hyperbola is in fact a sequence of chords for which the maximum deviation from the hyperbolic curve is less than 0.1 mm.

The programme is arranged in such a way that one hyperbola on a given plotting sheet is completed before the next one is drawn. A hyperbola may have two, or even six, points of intersection with the sheet lines, and this is illustrated in figure 7.

When choosing a suitable projection — in our case we used the Transverse Mercator projection — the hyperbolae can be considered as plane hyperbolae : at any rate they will not differ appreciably from the spherical ones. At present a programme is being developed for representing spherical hyperbolae on the plane of the projection used. That programme will then be independent of the chart projection, as long as this projection is known.

The principles of this system are very interesting, and it is a pity that I had to promise the inventor not to divulge them to you, or to give the set of formulae used. This would, however, have led to a lot of mathematics and this I think would not have been appreciated here.

To give you some facts about the time involved : a sheet measuring 60 × 120 cm (24 × 48 inches) and containing 40 hyperbolae is computed in about half an hour and then drawn in about one hour. A completely finished sheet is produced, showing the 10 cm grid, and 5-minute intersections, together with the hyperbolic lattice and lane numbering. The lettering is also done by the plotter. For one sheet we pay approximately five hundred guilders (Fifty Pounds Sterling) which is not considered expensive. If such a sheet were to be produced in the old-fashioned way the time involved would be roughly one month.