The theme of this number of Decca Navigator News is growth. In a period of national restraint and caution we are able to say with truth that we are making a significant contribution to this country's economic recovery.

In this issue we review the announcement of five new chains for South Africa. The installation of the six chains in Norway is proceeding at speed—two of the chains—the Finmark in the North of Norway and the Skaggerak in the South are already undergoing trials. We are now also able to disclose the Spanish Government's plan to erect a further three chains; two in Spain, the third covering the Canary Islands. The decision by Seaboard World Airways to equip their jet fleet with Decca/Decca has received enough coverage in the world's press not to require further comment from ourselves; suffice it to say that this decision by an airline well-known for the hard-headedness of its management speaks volumes for the status of Decca concepts at a time of growing air traffic congestion.

If the growth of Decca coverage increases almost daily the development of new receiver equipment keeps pace with it—we announce in this issue a new airborne receiver—the Mk. 15—which in terms of facilities, ease of operation, size and weight, marks—to use a very overworked word—a breakthrough.

In the military field the C130 aircraft now being supplied to the Royal Air Force constitutes an unprecedented Decca Full House with 22 separate items of Decca equipment including Decca Navigator, Doppler and Loran C/A being supplied to each aircraft.

Last and by no means least we announce the introduction of a new Survey system—Sea-Fix. So compact that it can be installed in a small buoy or carried in a suitcase. It will make a useful contribution to high accuracy position-fixing in locations impossible with existing systems.

Harco/Ommitrac was employed on scheduled airline service for the first time on 22 November, 1966, when it was installed in BEA's Argoysy freighter G-ATTC which is operating over a route network covering the UK and continental Europe. The equipment has been purchased by the Board of Trade for evaluation purposes, and after a short initial training period the BoT will be sending observers to assess the advantages that the navigational system offers the pilot and airline operator, particularly in congested ATC environments. Harco equipment is also currently under evaluation by A & AEE Boscombe Down with a fresh series of trials scheduled to commence shortly at CEV Brétigny.
The signing of the contract for Decca/Omnitrac equipment by Seaboard World Airlines is of great significance and marks a breakthrough in the long struggle for acceptance of the Decca concept of navigation.

Seaboard World becomes the first American Airline to install 'automatic area coverage navigation'. Instead of being restricted to tracks defined by beacons Seaboard World will be able to fly anywhere that ATC allows. Considerable saving of route mileage is expected as well as greater efficiency in being able to fly any required procedures in high density terminal areas without radar vectoring. Pilot workload will be substantially reduced by the automatic features.

Seaboard World Airlines was established 21 years ago and is the largest all-freight airline operating on the North Atlantic Route. As an indication of the managerial efficiency of this airline it is worth noting that whilst the rate of growth for the airfreight industry for the year 65/6 was 25%, Seaboard's business increased by 54%.

The airline now carries more freight in their all-cargo aircraft than any other carrier over the North Atlantic Route. They are thus the fastest growing all-freight airline in the world, growing twice as fast as the other 17 carriers in their industry.

Early in April it was announced from Washington that Seaboard World Airlines Inc, the only all-cargo airline operating on the North Atlantic Route, is to equip its fleet of DC-8 aircraft with Decca Navigator equipment. The initial order is for 24 sets of equipment worth approximately $1m. The decision, taken after a long programme of flight evaluation and analysis by the airline's Flight and Engineering Divisions of the many systems currently available, was reached because 'the system goes further than any other navigation system in providing effective and accurate cockpit automatic operation'.

John J. Casey, Senior Vice-President of Operations, said that he was convinced that this equipment, which will provide pin-point navigational accuracy on their routes between North America, Europe and the South Pacific, could pay for itself in route mileage saved by the ability to navigate accurately both en-route and in terminal areas.

Each aircraft will have a completely duplicated installation of Decca/Decra Mk. 17 Receiver, 'Omnitrac' digital computer and interface unit, and 'Flight Log' pictorial display. This comprehensive and versatile navigation system accepts a wide variety of navigational inputs which can be integrated, cross-checked and up-dated by the computer. In the Seaboard World installation the Omnitrac computer will have inputs from Doppler and VOR/DME as well as Decca/Decra. 'Vital information of the aircraft's track and position is displayed automatically and continuously to the pilot on the Decra 'Flight Log'. The system also provides autopilot coupling. With the Decca pictorial display the pilot can see his exact position and orientation at a glance; with a track trace of his flight the pilot can also judge the usefulness and accuracy of the facility he is using and can also visually average out any inaccuracies of the navigational input.

Seaboard World's Trans Atlantic route network based on New York, providing direct all-cargo service to and from all the main European trade centres is served by the fleet of Douglas DC-8F aircraft. Each aircraft can accommodate 13 loaded pallets plus bulk cargo. Load factors average over 80% and scheduled turn-round times of one hour are achieved with the help of mechanised loading equipment.
Any track, however complex, can be flown; thus relieving the pilot of many of the most urgent and complex computations. Decca/Omnitrac not only provides all this information automatically but also provides separate read-outs for ETA, ground speed, bearing and distance to any selected point, together with left/right indication to maintain any desired track. The Decca system, which will go into service as a completely duplicated installation, will be fitted initially for testing and FAA approval in a DC-8F aircraft in April of this year. The remaining seven aircraft will be equipped as they become available. The programme constitutes a major breakthrough in the science of navigation in that it is the first occasion that a major airline has equipped a fleet of modern jet aircraft with a navigation system matched to its performance.
After a searching evaluation the Government of South Africa has signed a contract for five Decca Mark 10 chains.

In the summer of 1945, one of the first public demonstrations of Decca Navigator was made at the Royal Aircraft Establishment at Farnborough. The occasion was the CERCA conference where a number of navigational aids were being discussed for the first time.

Some of the most interested visitors were representatives from South Africa who quickly appreciated the suitability of the Decca Navigator system for dealing with South Africa's air and marine navigational requirements.

Soon after the conference, visits were made by South African radio and navigation specialists and arrangements were made for a Decca chain and special measuring equipment to be sent to South Africa for an investigation into Decca performance in South Africa, an area with one of the highest radio noise levels in the world.

The trials took place in 1950 and valuable additions were made to our store of knowledge of Decca performance. The trials indicated that, with the techniques then available, exceptionally large stations would be required to radiate the necessary power, but interest continued unabated and, in 1958, a significant advance was made—the Mk. X system became available and a new trial was carried out.

The second trial showed the superiority of the Mk. X system and the economical operational feasibility of large scale adoption of Decca by South Africa and so approaches were made to various official organisations to arrange for the provision of the necessary funds.

After many discussions with various Departments, the Government approved the budgetary allocation and, on the 13th August last year, an agreement was signed between the Government and the Decca Navigator Company Limited.

In February this year the news was made public and the Minister of Defence, the Hon. P. W. Botha speaking at Stellenbosch, told of the Government's decision.

Five chains are now being built in South Africa and coverage will extend right round the coast from South West Africa to Natal. Receiver servicing depots are being set up so that South Africa will become another nation providing full coverage and facilities for ships and aircraft of all nations.
Pretoria, 19 August, 1866—British and South African officials and executives present at the signing of the contract. Top row, left to right: Mr. J. Prentice, Mr. E. Gallo, Mr. S. Hewitt, Mr. R. T. Duck, Brigadier Retief, Colonel Broadhurst, Mr. H. Dainty, Colonel Perkins. Bottom row, left to right: Brigadier Willmott, Lieutenant-General Martin, Mr. L. Rive, Mr. W. White.
In the past 20 years the study of electronic aids to navigation has become firmly established in the curriculum of the modern nautical school. It is now commonplace to find sophisticated electronic radar simulators and similar teaching devices in many such schools; these permit complex electronic navigation problems to be illustrated and solved in a safe, economic and instructive way.

We have for many years been associated with these educational endeavours and have installed Decca Navigator marine receivers on board training vessels operated by nautical schools and additionally have designed and supplied Decca Navigator Marine Simulators for classroom instruction.

An example of one such simulator in current production is the Type 2536A shown in the accompanying photograph. This equipment has been primarily designed to simulate the operation and performance of the Mk. 5 and Mk. 12 Type Decca receivers. It has been provided with calibrated dials to permit local setting up of the meter readings for both Lane Identification and Decometer indicators, this is of particular value when the Decometer display unit is remote from the simulator and it permits flexibility in instructional methods.

With the aid of this simulator it is possible to demonstrate the shipboard use of the Decca Navigator System under classroom conditions and in locations where the reception of actual Decca transmissions would not be possible.

More than 70 Decca Navigator simulators are installed in nautical schools, Naval establishments and training centres throughout the world; countries supplied to date are listed below: Australia, Belgium, Canada, Denmark, E. Germany, W. Germany, Finland, France, Greece, Holland, Italy, Japan, Norway, Spain, Sweden, S. Africa, U.K., U.S.A.
A new vessel for navigational aid training and marine research made its debut on the River Thames this March. It is the Sir John Cass which has been commissioned by the Governors of the Sir John Cass Foundation for the Department of Navigation, Sir John Cass College in the City of London.

On board, Merchant Navy Officers will receive practical training in radar and other navigational aids in nearly ideal conditions, where engine and generator noise and vibration have been cut down to a minimum, thus giving optimum efficiency for tuition and demonstrations. By arrangement with the Board of Trade she will have dual classification permitting her to offer both practical navigational aid training for Merchant Navy Officers and also to operate as a marine research vessel in the Thames Estuary and the North Sea under the supervision of the Department of Geology, King’s College, London.

The Sir John Cass is 99 ft 10 in. overall in length, has a beam of 21 ft 6 in. and a displacement tonnage of about 170. She is a twin screw, twin ruddered motor vessel with a welded steel hull and riveted aluminium superstructure and is powered to give top and cruising speeds of 12 and 10½ knots respectively. The new vessel is equipped to give training in all forms of position-fixing at sea and Decca Navigator Mk. 12 and Decca Hi-Fix will be fitted, in particular, for the marine research aspects of her work. Included in the training equipment is the Decca TM 616 radar incorporated with an automatic relative plotter; a Decca TM 616 is also installed on the bridge for navigation purposes. Closed circuit television enables pictures of the radar displays or other navigational instruments to be relayed from the demonstration rooms in the deckhouse or the ship’s bridge to the classroom in the ship’s hull.

There can be no doubt that this vessel is one of the finest examples of the progressive approach to training in the use of modern aids to navigation. Associated with the commissioning of the Sir John Cass is the announcement of a new College of Navigation presently building at Tower Hill, London, it, in conjunction with the Sir John Cass College and City of London College shall form one of the five new London Polytechnics.
Decca for aircraft to be tested in Finnmark

New Navigational System for the fishing industry may give ‘free’ Air Navigation. First trials in May

The first trials of the Decca Navigator system for air navigation in Norway are planned to take place in the Finnmark and Skagerak areas in May this year. If the system, which is at present being built for the fishing industry and for coastal navigation, proves fully useable and acceptable for air use, millions will be saved on the cost of building airfields. Air navigation based on Decca will be an extra bonus on the Decca Chats at present under construction.

A working group of representatives from the Civil Air Directorate, SAS, Braathens SAFE, the Air Force, the PTT and the NoJSA returned last Saturday from a demonstration in England. The group brought back an offer from the Decca Company of the loan of three complete Decca Navigator aircraft installations and the use of one of the Company's calibration aircraft.

The tentative plan for the trials this spring includes calibration of airfields in Finnmark by the Decca aircraft, and installation of two Decca Navigator systems in aircraft of SAS and Braathens SAFE—if the companies agree to the proposal. This part of the trials will be in conjunction with the Decca Chain at Finnmark which will become operational in February/March of this year. Similar chains of ground stations will be put into operation for the Lofoten and Vestlandet areas in the autumn of 1967 and in the Helgeland and Trøndeal areas one year later. Because of pressure from the fishing industry a speeding up of the construction programme is now under consideration which will give Decca coverage for the whole of Norway by the end of this year.

Decca for fly skal prøves i Finnmark

Nytt navigasjonsystem for fiskeriene kan gi «gratis» flynavigasjon - første prøve i mai

De første prøver med navigasjonsystemet Decca for flynavigasjon i Norge er planlagt i mai i år, i Finnmark og Skagerakområdene. Hvis systemet, som er under utbygging for fiskerier og kystnavigasjon, viser seg å være fullt brukbart og eventuelt kan godkjennes også for flynavigasjon.

Front page 'Aftenposten' (Oslo) 23rd January 1967

The chairman of the working group, Erik K. Boger, Technical Director of the Norwegian Joint Signals Administration told 'Aftenposten' that the Decca system will cover practically the whole of Norway with the very high degree of accuracy which has come to be expected of this navigation aid. The group is constituted by the Civil Air Directorate, and has a mandate to evaluate Decca for air navigation use in Norway, and to establish rules and regulations for its use if found acceptable. The Decca Navigator equipment demonstrated to members of the group in England is fully transistorised and very compact. It comes in a range of sizes—including large complex systems with an electronic computer which enables data from various navigation aids, required by the pilot, to be collected and read out on a single display.

Position on a Flight Log

Decca air navigation equipment includes a pictorial display which shows at any time the aircraft's position in relation to the ground. The accuracy shown during the trials was extremely high. Civil air authorities in England are considering the Decca Navigator system for widespread use. In Norway, Decca will be used for en-route navigation and as an approach aid, in some cases taking the place of ILS, the installation of which costs 1.5m N.kr. per airfield. In this connection, the popular argument is that ‘Decca is free—ILS costs as much as a minor new airfield’. Government acceptance of Decca for air navigation will not involve additional cost for ground stations. The only additional investment will be by airlines and aircraft operators for receiver equipment. The airlines are not yet completely positive but have confirmed their willingness to evaluate the system.
Mr H. G. Hawker accepting from the hands of Colonel Bjorn A. Rorholt of The Norwegian Joint Signals Association (Forsvarets Fellessamband) a cheque for £150,000. The occasion was a lunch at Kastrup Airport, Copenhagen, on 1st June 1966 given to the Norwegian Delegation to demonstrations in our aircraft there.

The payment was a second instalment under the contract for the sale of equipment for the Norwegian Chains and marked the selection by the Norwegian Authorities of the Decca design for a transistorised power amplifier for their stations which was in competition with the designs of American Companies.

The construction of the Norwegian Chains is now well under way with the Finnmark and Skagerak Chains already on the air. The Norwegians, swift to appreciate the economies offered by this true 'common system', as detailed in the report from 'Aftenposten', are now about to embark on an evaluation of the Decca Navigator System for airborne use.

The stations are designed to run unattended and will only be visited for routine checks every thirty days. Full information on the performance of all the stations in the chain is continuously transmitted by a data link transmission and recorded on multi-channel pen recorders (photo) at a central control centre. The operator at the control centre has an over-ride control over the essential functions of the chain.
In December 1966, the first C130K Hercules aircraft destined for service with the Royal Air Force arrived in the United Kingdom on schedule after a near perfect trans-Atlantic ferry flight from the Lockheed-Georgia aircraft plant. For the next few months a steady stream of these aircraft will continue to arrive and when the last one is delivered this will close what already promises to be an extremely successful chapter in the history of the British avionics industry—a success story which may prove to be highly significant to the industry's future. Competition was naturally very keen amongst British firms to have their equipment accepted for the final avionics fit. However, the joint interests of our electronics firms were handled by the Electronics Engineering Association, who were the spokesmen during contractual negotiations with the Ministry of Aviation, and who represented the firms during subsequent discussions with Lockheed-Georgia. This concerted approach by a single body, speaking on behalf of British electronics interests, proved to be a very effective negotiating technique in the face of fierce competition from the American avionics industry.

Proposals were drafted which outlined the optimum avionics fit which could be achieved within the specified time—scale and cost brackets. Once the proposals had been accepted, the EEA coordinated the efforts of the British electronics firms concerned, to ensure that the customer requirements were met. The Hercules project represented a particular challenge to our Company, since it called for a comprehensive navigation system comprising—Decca Navigator, Doppler, Loran C/A, computers, displays and fix-up-dating aids. Stringent time-scale and budgetary limitations made it virtually mandatory that the components should be “off the shelf,” although in some instances further development work was necessary in order to meet the specific requirements of the Royal Air Force. Above all, the specifications called for a high order of performance, in terms of accuracy and reliability.

The Decca Type 62M2 Doppler was proposed as one of the primary sensors, since it was already in quantity production at an economical price and its performance was capable of meeting the specification. Three computers of the Decca 9476 family were adapted to provide outputs to the Lat/Long and Along/Across Track Display Units and to the Roller Map Type 9275. Thus far, the navigation system as proposed would provide continuous readouts of position, in terms of geographic and along/across track co-ordinates. It was necessary, of course, to provide the capability to update these positional readouts. To achieve this over a large proportion of the aircraft's probable operating areas, it was proposed that the Decca Mk.1 Air and the ADL21 Loran C/A equipment should complete the system. The Decca Mk. 1 Air is well known to the Royal Air Force, being already fitted to a large number of service aircraft. The receiver drives three Decimeter Indicators calibrated in zone, lane and lane-frac- tion units for the red, green and purple patterns, from two of which a fix may be manually plotted on a grid map or chart. A Lane Identification Meter gives a periodic and independent check on the counting of the successive lanes passed through, and avoids the need for more than a very rough initial knowledge of position. The receiver also drives, through a computer unit, the Flight Log Pictorial Display which is installed for use by either pilot.

The basic outputs of the Doppler System are drift angle and groundspeed and these are displayed on a separate Groundspeed and Drift Meter. Drift information is also applied to the magnetic heading input within the system and the resultant magnetic track is fed through the Variation Setting Control Unit which is housed in the Lat/Long Display Unit. The Master Computer (one of the three 9476 variants) accepts the true track angle from the VSC, along with doppler groundspeed or ‘incremental distance’ data. In addition to computing lat/long information for display on the appropriate unit, this computer also acts as a repeater, relaying true track to the Roller Map and the Along/Across Display, and incremental distance to the other two computers. A chart angle correction within the Roller Map ensures that Roller Map Computer is properly orientated to the aircraft’s true track. Finally, the Along/Across Display shows distance along two successive tracks, called Leg A and Leg B, and the across track error. Maximum readings are 999 and 99.9 n.m.s respectively. The Auxiliary Along Track Display has the capability of increasing by tenfold the sensitivity of the across track error readout.

Finally, there is the Decca ADL21 Loran C/A equipment, comprising a receiver, with separate numerical and CRT display units, which can work with Loran A and C hyperbolic position-fixing systems. In the Loran C mode the ADL21 is semi-automatic in operation. Once the receiver is locked on to the required signals, the coordinates of two position lines are displayed alternately on a digital readout. This semi-automatic operation results in an improved performance when acquiring the signals and when operating in the fringe areas of Loran C cover.

The results of this overall exercise to “go British on the Hercules” were truly impressive—and should give fresh heart to those who express concern about the viability and efficiency of British industry. In the relatively short period of 18 months, contracts were laid, equipment produced and delivered, installations approved, initial flight tests completed and the ferry programme started. All this work was achieved within the planned time-scale, and equally significant, within the stipulated costs. Of course, the British firms concerned can only claim part of the credit for this splendid achievement. The Lockheed-Georgia Company and the Ministries of Aviation and Defence were largely responsible for the efficient and timely progress of the whole project. Nevertheless, our industry can reflect with considerable satisfaction on the part that it has played. Moreover, it is safe to assume that this creditable performance has not passed unnoticed by potential customers in the export field, particularly in the U.S.A.
THE HERCULES GOES BRITISH

The complete Mk. 15 installation including Receiver, Computer type 1910, Zone Identification meter, Controller and Display Head type 961 weighs approximately 35 lbs.

The aircraft is flying over some conspicuous feature, such as a reporting point, beacon, small lake or village marked both on the chart in use and on the overlap of the new chart about to be brought into the Flight Log aperture.

On selecting FIX on the controller, pen tracing ceases and the computer immediately begins to store increments of the Decca co-ordinates.

The new chart can be run in at the pilot's convenience after pen-positioned on the previously noted feature, OPERATE is selected, tracing is then resumed.

If the new chart also requires a chain change this would also be automatic once 'Fix' is selected on the controller after referencing.

The introduction of the Mk. 15 solid state receiver represents a major advance in the field of airborne navigation and forms the basis of a new generation of Decca systems with a standard of performance and simplicity of operation never before achieved. Furthermore the equipment is both lightweight and compact. A logical development from Decca valve-operated Mk. 10 equipment, Mk. 15 incorporates the experience of millions of flying hours on the earlier systems—installed in thousands of aircraft of the world's leading Airlines, Defence Forces and countless private operators.

The Mk. 15 transistorized receiver, together with its associated computer, zone identification meter, Flight Log and controller, forms the ideal navigation system for a wide range of aircraft from the smallest piston-engined executive types to the latest and most sophisticated civil and military jets.

Semiconductor circuitry and modular construction gives the Mk. 15 increased reliability with reduced size and weight and low power consumption. An advanced design concept and many technical innovations enable the new system to combine semi-automatic operation with an accuracy ten times greater than that of the equipment it replaces.

Like all Decca Navigator equipment, Mk. 15 operates in conjunction with ground-based transmitter chains. A chain consists of a master and three slave transmitters which radiate phase-locked unmodulated signals forming a stable pattern of hyperbolic position lines with the stations as foci. Each position line is formed by points of common zero phase difference between a master/slave pair: the area enclosed by adjacent position lines forms a Decca lane.

In the case of earlier Decca equipment, position in and passage through the position line lattice was indicated on Decometers (phasemeters) one for each pattern the readings of which were used to set up the Flight Log. Mk. 15 eliminates Decometers and the output is now in terms of Decca Zones (groups of lanes). The only indicator other than the Flight Log is a single zone identification meter. Position fixing within the zones is automatic after referencing and requires no intervention by the pilot whatever.
An innovation in Mk. 15 is the provision of a Run/Fix facility which makes chart and chain changing far simpler than with earlier equipment. This is accomplished in the computer which stores the Decca position line co-ordinates during the chart change. On selecting the new chart the pilot only has to place the pen on a clearly marked reference point and the Flight Log then automatically takes up the correct position.

Users of earlier Decca equipment will be immediately at home with Mk. 15 which uses the same Flight Log and charts as previous systems. Improved reliability, and simplified operating procedures mean that Mk. 15 makes far less demand on the pilot particularly at the critical phases of flight.

No Chart-Change Errors

'Run/Fix', an important innovation in the Mk. 15 system, eliminates errors due to loss of continuity during Flight Log chart changes. Run/Fix is a memory device in the new Type 1310 computer which stores the Decca co-ordinates during the chart-change operation. The actual change can be unhurried and entirely at the convenience of the pilot.

When the new chart is in position the Flight Log pen will automatically position itself correctly from information output from the computer. Run/Fix thus reduces chart-changes to a simple semi-automatic procedure.

Chain Selection

There is no chain selection control, this function being performed by the Flight Log turret switch.

Malfunction warning

To indicate failure of either the incoming signal or in the station itself, a malfunction warning light is provided on the controller. A continuous check is provided by the zone identification meter which should indicate zero at the commencement of every zone setting cycle. As with all Decca Navigator Systems, the self apparent quality of the pen trace is assurance of the correct operation of the equipment. The memory provided by the locked oscillator of the Mk. 15 receiver will automatically override small interruptions in reception.

Flight Log Charts

Mk. 15 employs the same display head (Type 961) as earlier Decca Systems and users familiar with the previous Decca installations will be immediately familiar with Mk. 15 presentation. Flight Log charts for Mk. 15 differ only in their lattice presentation which is now in terms of Zones. Chart scales and orientation are fully compatible with previous systems.

Zone Setting

The Mk. 15 receiver measures zone fractions (to approximately 1/1000 of a zone) rather than lane fractions as in Mk. 8A equipment. Lane units are therefore not used, and zone ambiguity within a group of five zones is automatically resolved three times a minute without intervention of the user. Normally the pilot will know his position to within one zone but as an independent check the zone identification facility is included which positively indicates the zone in which the aircraft is located within a group of five zones.

High Speed Capability

The Mk. 15 system can be used in the most modern jets. Compact construction, low weight and high accuracy make it specially suitable for high performance aircraft. The only limiting factor affecting Mk. 15 high-speed operation is the speed of the Flight Log paper drive which even under the most critical condition (i.e. the aircraft flying along an inter-station baseline) can follow the aircraft up to 1600 knots with a 4½ inches per zone scale or 800 knots at 9 inches per zone.
The number of business and executive aircraft to be equipped with the Decca Navigator grows continuously. The following reports from two quite different users go far to explain its growing demand.

It is very difficult to be original and say something of the merits of the Decca Navigator System that has not already been said. However, we give you some of our thinking on this matter as it applies to the particular type of flying that we are involved in.

We are a 'Two Company Aircraft Operator': that is to say, we fly single crew, have two pilots and three aircraft. This allows for continuous maintenance without normally upsetting our aircraft programme.

In the year October 1965 to September 1966 we made 1750 flights, carrying 3150 passengers over a straight line mileage of 179,000 miles.

Well over half of our flying is 'off airways' and this means that the location of existing 'aids' is not to our best advantage.

'The shortest distance between two places on the Earth's surface is along a straight line, etc.' This being so, accurate track keeping is essential. To accomplish this without using Decca you are faced with the old method, viz., met. wind, creaking computer, assumed airspeed and a piece of lodestone that points vaguely towards North. Having flown for about 10-15 minutes using the wavering needle of the VOR or ADF a fix is obtained of doubtful accuracy. From the displacement off track a new course, ground-speed and ETA are computed and so on. Trial and error at its best, the resultant flight becoming a series of irregular facets instead of the smooth gem it should be.

Using Decca does not absolve one from the above procedure with all its built-in errors, the essential difference being that having carried out the mathematical exercises the errors are shown up immediately by the aircraft not making good the track. As far as the ground-speed is concerned, it is a simple matter to punch the stopwatch on the 10 mile lines, the accuracy increasing as the flight progresses.

I am often amazed at the mental agility and dexterity of some aircraft commanders that I know who are not using Decca. They must have the ability to draw scores of lines from VOR sites in a very short space of time when their dulcet tones announce that 'Yankee Alpha is clear of Blue One'. We prefer to wait until that pen on the Flight Log Chart is clear before making such a statement of fact. Of course, by all means check it with some other piece of equipment—it costs you nothing. We think it is a relatively easy matter to stay on the 'Airway'—they are designed with this object in view. It is entirely a different matter to know exactly where you have joined or are just leaving controlled air space.

With the above in mind, consider the work load on the pilot as far as navigation is concerned on one of our regular flights from Tatenhill to Southend without the use of Decca. Tatenhill being situated below Airway Amber One, how far along track can you go before you are clear of the 'Airway' so that you can climb to your cruising altitude? Your next problem is deciding when you are at the FIR boundary 52° 30' N. Next you have to make sure that you don't infringe the Cardington Balloon area. Having sorted this out, are you going to fly below Red One outside your optimum altitude and get mixed up with the Stansted traffic? If not, you must cross the 'Airway' and the next problem is to sort yourself out at any Matching. When clear of the 'Airway' you are next faced with a fairly quick descent (unless you elect to do this in 'the hold'). This being the case, how do you position yourself so that when Southend ATC takes you over you have positioned yourself to the best advantage to be fed into their traffic pattern?

Using Decca the whole progress of a flight can be seen at a glance without any action on behalf of the pilot apart from chart changes (one in the above instance) and an occasional check with the 'lane ident'. At any one moment you know where you are, how far you have come and remaining distance to your next problem.

When aircraft are not gainfully employed in the transport of passengers in the widest possible sense they should be on the ground leaving the air space free for those who have this to do. If this rather crude analogy is accepted then the less time we spend in 'the hold' or letting down or positioning ourselves the better. It is, of course, accepted that we will have to come under radar control, etc., but this can still be done to the best advantage if you know precisely where you are and can monitor your subsequent actions.

The integration of Decca with the National Air Traffic System has been gone into elsewhere and needs little comment from this writer, except to say we've tried it on many occasions, e.g., from FIR boundary 'Decca right' to Clacton, 'the Park'—Woburn, then overhead Deventry and so to Birmingham, and its works.

As far as the economics are concerned, it needs little imagination to see that accurate track keeping saves mileage and bearing in mind that in our aircraft one complete two minute race track pattern involves at least 15 miles then we can estimate a saving in the previously described flight in the order of 10% or 12 miles at what?—4/-, 5/- or perhaps 6/- a mile.

What do you get from Decca depends on how you use it and to do this to the maximum advantage it is up to the operator to decide what Flight Log Charts he wants and what information he wants printed on them. Because of the continuous changes that occur in our Air Traffic Control system we have found that a periodic visit to the Decca Charting Department, where the whole flying programme and routing can be gone over, selecting the most suitable charts, is a method worthy of consideration.

To conclude, you may think we are Decca biased; we are and proud of it.

By Captain David Lancaster Chief Pilot Ind Coope Ltd
THE AUTOMOBILE ASSOCIATION

The Automobile Association’s appreciation of the future of the light plane was formed and acted upon as far back as 1909. Since then its aerial activities have come under two heads—AA service for aircraft owners, and the use of aircraft to support its own activities.

Even back in the 1930s the AA was finding ‘congestion’ on the roads and was playing a major part in developing the use of light aircraft as means of transport.

The present AA-owned aircraft is an American Piper Apache, Model 23A, with two Lycoming engines (160 h.p. each) fitted with constant speed propellers which give a cruising speed of 150 m.p.h.

With one eye on the roads, and the other on the air, the AA started its own aviation section in 1929 to provide members with navigational maps for flying, foreign touring services information, and schedules of airfields. A special AA ‘flying squad’ was formed to deal with aircraft reception and parking problems at big events like the Grand National and air shows. The AA also played a large part in planning the routes and schedules of many of the pioneering long distance fliers of those days. Amy Johnson’s famous Gipsy Moth, in which she flew solo to Australia in 1930, displays two AA badges where it now ‘flies’ suspended from the ceiling of the South Kensington Museum.

After the second World War the AA was fully alive to the part communications would play in its future, and therefore began to build up its own radio network, linking patrols to area offices, and area offices to each other, and once again took to the air.

In 1956 the AA bought an Auster Alpina and proved again to its own satisfaction that the light aircraft was of immense value to a motoring organisation in helping to keep an eye on ever increasing congestion down below. After 12 months the AA replaced the Auster with the bigger de Havilland Rapide which had a higher speed and better bad weather capabilities.

The present Apache, purchased in 1963, carries a total of eight radio installations, two of them for aeronautical frequencies and two for AA air-to-ground communications—one linking the aircraft with AA offices, the other with AA mobile patrols.

The remaining four are purely navigational aids which, with a Decca Mk. 8A and Flight Log, make it one of the best-equipped light aircraft in the country. Road planners are given flights to enable them to get a bird’s eye view of future prospects—and past mistakes. On several occasions it has flown emergency food packs to the men of the AA Highland Patrol, who operate in the remote parts of Scotland, when snow-drifts had cut off supplies.

A certain amount of executive flying also features in the programme, of course. But it is probably best known for its ‘spotter’ role at holiday times and when big traffic-attraction events are in progress. Often with police on board as well, the Apache can alert patrols of blockages and impending hold-ups, spy out alternative routes—and even ‘home’ a patrol to a broken-down vehicle before the member has set off on foot for a telephone box.

*“The decision to fit Decca in our Apache aircraft was taken for the following reasons—*

1. Because of our widespread coverage throughout the United Kingdom, it was often more convenient to operate from the smaller airfields which had no landing aids. Diversions often had to be made in the past, and it was felt that Decca would minimise this.

2. The aircraft is used for photographic surveys of new roads, junctions, etc., to enable our own Drawing Office to make the necessary maps from the photographs. In 1963 the whole of the Greater London Area was photographed from our Rapide, which we then owned, and it was found very difficult to fly accurately enough to ensure complete coverage, particularly as it was necessary on occasions to ‘hold off’ because of the needs of Heathrow. It was found that there were two alternatives. Either to have a very great overlap on the photographs to ensure coverage, which is obviously very wasteful, or to accept some gaps in the coverage. It was felt that Decca would enable accurate courses to be flown and exercises of this kind to be carried out with the minimum of waste of time and material.

3. The Director-General, who came to us from Shell, had been used to flying in aircraft equipped with Decca, and he was of the opinion that this modern navigational aid was a ‘must’ for an executive aircraft.

All these reasons have proved correct and it is fair to say that we could not operate without Decca now that we have, so to speak, ‘tasted the fruits’.

On these types of operation we have saved a great deal of time and, therefore, expense, by being able to take short cuts.

To sum up, like so many other modern aids in whatever sphere, it is now, in retrospect, difficult to see how we managed without Decca in the past.”*

*An AA report on Decca*
The Sea-Fix system based on Hi-Fix techniques is intended for short range operations with either land-based or buoy-borne transmitters for: Dredging, Hydrographic Survey, Minesweeping, Beacon Control, Ship's trials and other functions requiring control over small areas.

The system was first used operationally by the National Institute of Oceanography to investigate the 'Cantabria Sea-Mount'.
Before our sea-legs arrived the Discovery steamed into a gale, sorely depleting the work effort, and the appreciation of the nine-course six o'clock tea was delayed by several lanes.

At Coruna a Sea-Fix buoy was lowered overboard for a short test—then out into the Bay once more to carry out the scientific measurements and to examine the sea-mounts. On arrival at the Cantabria Sea-Mount (Lat 45°N, Long. 8°W) Slave 2 buoy was moored and placed over the side. The ship then stood off and at a distance of some 500 yards the Pattern II lane number was obtained by range-finder. Discovery steamed eastwards and after 10 miles, about 240 lanes, the Slave 1 buoy was anchored and put overboard. The Pattern I lane number was found and the interslave 'baseline' length was determined in the usual manner. For plotting the ship's course two families of circles had been drawn on separate sheets of paper at half an inch to the mile. These were now superimposed on each other to give the correct distances for plotting, and the position of the ship was recorded at five-minute intervals. Echo soundings, magnetic and gravity measurements, and seismic recordings were made at the same time. A contour map of the sea-mount was drawn and revealed the existence of a cliff on its northern slope. The deep sea camera was lowered into the depths and confirmed the presence of rocks, samples of which were subsequently brought to the surface by dredge.

While navigating by Sea-Fix, readings of the Decca S.W. British and N.W. Spanish (nearly operational) chains were noted. Radar fixes were taken when within radar range of the buoys. These additional navigation aids brought to light the relative movement of the Slave stations as a result of the length of mooring wire and variations in wind and current. Such a movement did in fact occur to the Slave 2 buoy which was then fixed by Decca and the plot suitably modified. The method of mooring used on this occasion was by no means the ultimate and considerably improved stability was attainable, for instance by a submerged flotation taut mooring or a triangular complex of three wire moorings.

A Sea-Fix Slave station about to be launched and ... at sea.
The Spanish Ministry of Public Works has announced details of a plan to extend its Decca Navigator coverage to include the South and East coasts and the Canary Islands area. The North West coast is already provided for by transmitting stations completed recently in Galicia.

The equipment, as in the case of the chain in service, will be made under licence in Spain although a significant proportion of the components necessary for the manufacture will be supplied from Great Britain. The total value of the three new Chains comprising twelve transmitting stations is more than £1,800,000 including buildings and services.

Sr. Santiago Udina Martorell, Under-Secretary of Public Works, announcing the programme said the cost of the complete plan of improving maritime navigational services around the Spanish coast would be more than £11 million and in addition to the Decca Navigator system would include beacons, lighthouses, port lights and acoustic signals; together they will form a system of the most modern concept and design.

The Decca Navigator Chains will provide a system of continuous highly accurate position information not only for the Spanish vessels but for the ships of all nations from oil tankers, passenger liners down to fishing vessels and coasters.

Already more than 200 Spanish vessels are fitted with the Decca Navigator and use the system in North West Europe. The new chains will bring about a considerable increase in the numbers of installations and already receivers manufactured under Licence in Spain are coming into service.

The Spanish Navy, always a strong supporter of the Decca Navigator System, uses in addition Decca Hi-Fix and Decca Lambda Survey Chains for their hydrographic requirements.

Many of the airfields associated with the important tourist industry fall within this extension, therefore, the system can also make a contribution to the safety and economy of the rapidly growing air traffic in Spain.
On the completion of the plan the entire coastline of Spain and the Balearic Islands will be covered by Decca. The diagram shows the existing chain with the proposed new chains in the south and east. (Broken lines indicate planned chains.)

Proposed Decca Navigator coverage for the Canary Islands.
Decca Arkas Autopilot permits effective fishing along complex depth contour of Arctic Continental Shelf.
Skipper Bob Gray adjusts his Arkas Model L.G.B. Gyro Autopilot in the wheel-house of *Arctic Galliard*.

*Arctic Galliard*—a romantic name for a ship doing a job which is far from romantic. It is, however, in keeping with the swashbuckling names given by Boyd Line to all their trawlers.

The *Galliard*, originally built for Marr & Sons and named *Kirkella*, was sold to Boyd Line early in 1963. She is a side trawler, 190 ft in length and has a triple expansion steam engine giving her a service speed of 13 1/2 knots.

At this time of the year she works the Norwegian coast and contributes significantly to the landing of fish in the Humber area. At other seasons she operates in the fishing grounds around the White Sea, Iceland and Greenland.

Bob Gray has been in command of *Galliard* for the past four years. Like many successful skippers he has no set rules for success but has various ‘tricks of the trade’ which the layman would probably interpret as intuition.

He is forward thinking in regard to equipment, and, due to the arduous nature of work on a fishing trawler, is keenly interested in any new development that makes his job easier and more profitable. Recently he asked his owners to install the latest Arkas Autopilot, coupled to the gyro compass on board.

After many months experience with this equipment he recently expressed his keen satisfaction with its performance and told us of a recent trip which included fishing on the Malangan Bank. This Bank requires accurate position and track keeping, as the correct fishing depth of about 180 fathoms can easily become a disastrous 680 fathoms in no time. Having a peculiar shape, this Bank requires drastic course alterations by the ship if the contours are to be followed successfully, and the best fishing results obtained.

In his own words:

‘The ARKAS Autopilot was in continuous use during trawling operations on the Malangan Bank where large alterations of course have to be made to keep at the correct fishing depth. Strong tides are present, but by selecting the correct amount of rudder limit to be applied by the ARKAS, the exact amount of turn was achieved automatically. Course alterations are from West by South to East North East, then North East, North West, North and finally North East during the tow.

Coming home, the ARKAS steered well in Force 7 with the wind on the starboard quarter.’

Despite these gyrations, Bob Gray reports that his ARKAS Autopilot coped with all course changes in the automatic mode by finger-tip control, and with more precision than could be achieved by the best helmsman. This left him free of the steering problem and gave him more time to get the best out of other electronic equipment.
Decca/Omnitrac provides full navigational flexibility compatible with current radar control techniques thus improving the use of air space and reducing ATC delays. Only hyperbolic systems can provide all the following facilities:

1. Defining minimum distance tracks within the airways system. Operational research studies of airline route networks have shown that route mileage savings of the order of 2-2½% can be obtained from the use of an accurate area coverage navigation system pictorially presented on the flight deck.
2. Defining new and more direct routes additional to those now based on point source aids.
3. Complete navigational flexibility without radar vectoring for navigation both in the en-route and approach phases.
4. As an intermediate and final approach aid the pictorial display provides both synthetic glide slope and runway centre line extension.
5. Simplifying the circling procedure to a runway not lined up with ILS or a VOR radial, or avoiding the circling procedure altogether.
6. The easing of cockpit workload: Decca Omnitrac provides autopilot coupling for flight profile control with bearing and distance readout to any selected point - at the touch of a button.
7. Improved co-operation between flight deck and ATC - The Decca air/ground Data Link is a vital component of modern automatic ATC systems.
8. Multiple-track route structures designed to increase ATC system capacity and thus reduce delays in congested airspace. Use of the Omnitrac computer permits non-radial courses to be flown on VOR/DME.
9. The safe reduction of separation standards with an inherent improvement in punctuality and a potential increase in system capacity.
10. Use of pictorial display not only enables the size of holding areas to be greatly reduced, but also permits patterns to be accurately flown. With Decca, holding areas can be designated regardless of siting of ground aids.
11. Omnitrac provides autopilot coupling for flight profile control, and permits direct comparison of position derived from VOR/DME or any other input.