

# Radars Systems International

**MARCONI**

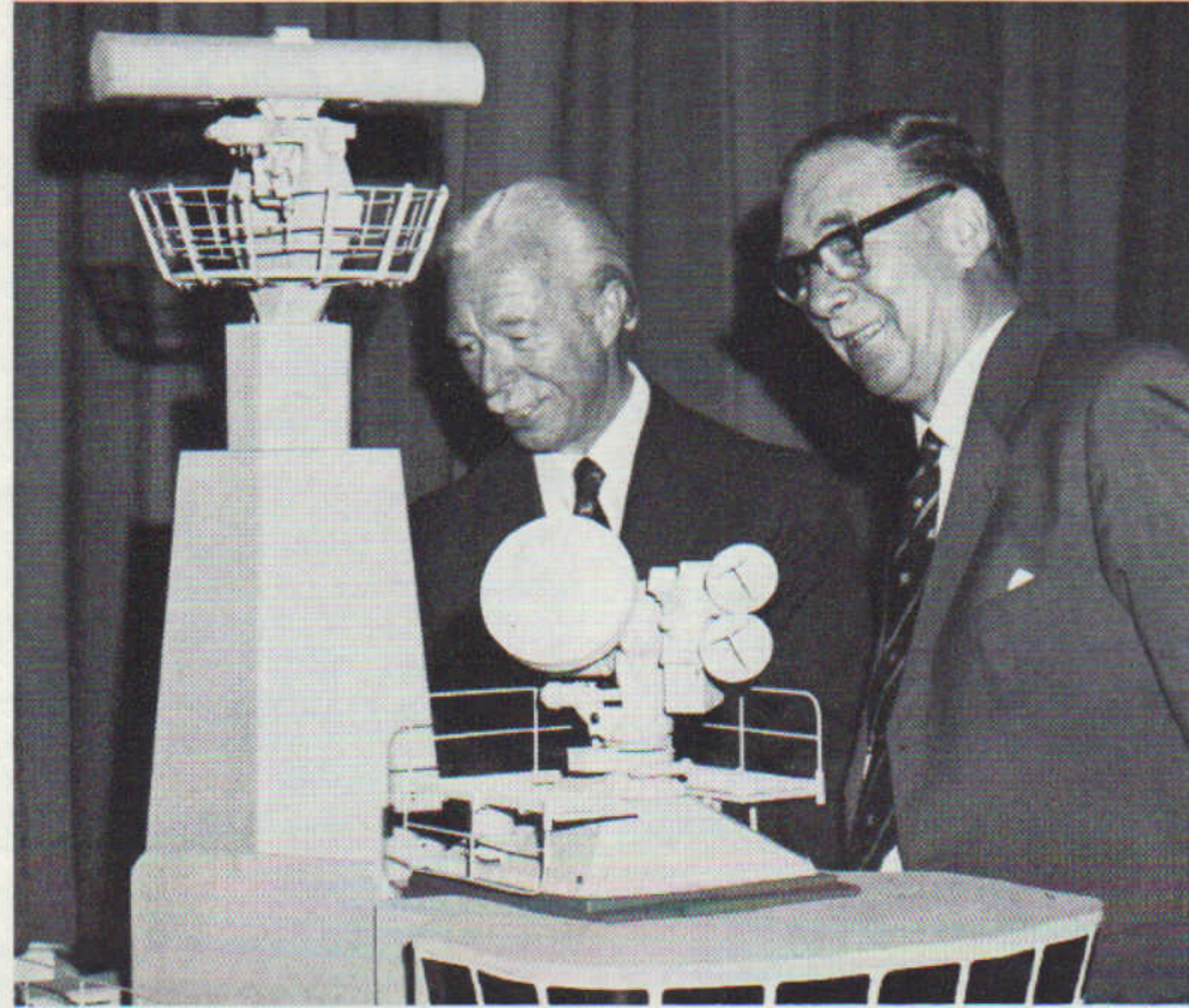
No. 12

## Marconi Radar at Greenwich

Following a series of successful firing trials, a contract has been placed by the Ministry of Defence (PE) to cover long lead items and planning for early production of the GWS25 system, Seawolf.

A working model of this all-electronic system will be on show at the Royal Navy Equipment Exhibition at Greenwich, together with models of other radar systems such as the 909 Seadart system and the privately funded 800 Series of weapon radars. The fully automatic Seawolf equipment is nearing the end of its development and will give ships' defences a punch undreamt of even ten years ago.

Other Marconi Radar Systems' naval equipment on display will include a static frequency changer, a de-gaussing system cubicle, electronic equipment to protect a ship's hull from corrosion, and a beacon that can identify itself on a radar screen.



Working model of GWS25 surveillance and tracker radars at Greenwich

ROYAL NAVY  
EQUIPMENT  
EXHIBITION  
1973

Stand  
18

MARCONI  
RADAR SYSTEMS  
LIMITED

## Lightweight beacons identify themselves

Marconi 'Sea-Watch' racons, responder beacons that are triggered by a ship's radar to identify themselves and their position on the ship's radar screen by a predetermined 'dot-dash' code, are in use throughout the world as general purpose all-weather navigational aids for marine use.

Now, based on their well-proved Sea-Watch 300 design, Marconi Radar Systems at Leicester is manufacturing a quantity of lightweight racons for the Middle East.

The new racons consist of an electronics module and a fully weatherproof aerial unit. Power consumption is modest, less than 1 watt from any 8 to 36 volt d.c. power supply, enabling the racon to operate for long periods from small battery packs. The system can be deployed by one man and can be set up for use within minutes. The range can extend to 40km (22 nautical miles) and even under unfavourable conditions the range is greater than that of passive radar reflectors. Up to 58 preset identification codes are available which present, on a ship's radar PPI display, a morse-like response at the racon's position. The system utilizes all solid-state electronics and there is therefore no warm-up time. If required the racon can maintain silence until activated by a command over an associated radio link.

When the racon is installed in the proximity of a pulse radar, gating interconnections can be made to inhibit mutual interference. This facility is useful when mounting racons, as an aid to station keeping,

on radar-fitted ships in convoy, such as flotilla of minesweepers or landing craft.

A wide choice of static omnidirectional and beam aeriels is available. The directional aeriels are especially suitable for marking assault beaches or harbour approaches. The aeriels are small enough to permit the racons to be installed in aircraft and helicopters, with the electronics module inboard, where they may be of particular value in air-sea rescue service.

Lightweight racons have, of course, many other applications and are particularly suited for mounting on small buoys, where the compact size and light weight of



A lightweight Marconi racon

## MARCONI RADAR SILVER

Saturday 14th July was a milestone in the history of Marconi Radar Systems Limited. On this day, twenty-five years ago, the Services Equipment Division of Marconi was formed under the management of Colonel E. N. Elford, to handle the Company's growing radar business. S.E.D. was soon to be renamed Radar Division and in 1960 became the nucleus of Marconi Radar Systems Limited. The other parts of Marconi Radar Systems were the Airspace Control Division of Elliotts and the radar and defence interests of AEI. The latter, under their earlier names of Metrovick and BTH, had of course been in the forefront of radar since the 1930s.

The Services Equipment Division of Marconi, from a group of fourteen men with a £1 million export contract in 1948, has now grown to full Company status employing nearly 5000 people and with an annual turnover of about £30 million.

the aerial unit permit high mounting to give a good horizon range without compromising stability. Obvious applications would be for marking wrecks and temporary obstructions or for use as markers when cable laying.

Several organizations are investigating the possibilities of using vehicle-mounted civil marine radars, for example, the Marconi 'Radiolocator' series is being considered in conjunction with aircraft-mounted racons to form a cheap and effective surveillance/transponder system for crop-spraying and similar activities.

The growth of the Company is punctuated with impressive 'firsts', including complete responsibility for two complete generations of Britain's air defence radar network. It built Europe's first computerized air defence system, as well as the original NATO defence radar chain and is now the only British member building the current international NATO Air Defence Ground Environment project.

Growth in the civil sector has been equally impressive, with the Company supplying most of the radars for the UK Airways Surveillance Systems, and culminating recently in the handover of two of Europe's most advanced automated Air Traffic Control systems—Flight Plan Processing in the UK, and the Eurocontrol off-line data processing system for optimizing control procedures under realistic conditions.

Seen here, in front of a Marconi S600 Series radar, is Colonel E. N. Elford, OBE (right), the original manager of the Services Equipment Division. With him is the present Managing Director of Marconi Radar Systems Limited, Mr J. W. Sutherland, who started his radar career with AEI, in 1941.



## Radars Systems International

published quarterly by

MARCONI RADAR SYSTEMS LIMITED

A GEC-Marconi Electronics Company

Crompton Works, Chelmsford, England CM1 3BN

Telephone: Chelmsford 67111. Telex: 99108

# THE 800 SERIES TODAY— the new radar generation

The Marconi Radar Systems Company now offers new equipment to meet the radar and fire-control requirements of small warships. This equipment, designated the 800 Series, is also suitable for the control of missiles and guns in the defence of larger vessels, and in a land mobile form for use in coastwatching, coastal defence, and the protection of strategic points from attack by low-flying aircraft.

Highly successful trials have recently been carried out at the Royal Navy gunnery range at HMS Cambridge and at the missile range at RAE Aberporth. The 800 Series equipment is being demonstrated at Marconi Radar Systems, Leicester during the period of the Royal Naval Equipment Exhibition at Greenwich.

The 800 Series includes surveillance radars and tracking radars and is supplied complete with control equipments for missiles and control and prediction systems for guns. The tracking radar can also operate in a surveillance mode and this configuration gives excellent detection performance against low flying aircraft and sea skimming missiles. The 800 Series equipment operates in the X-frequency band and is tunable over a wide range from a single operator control. Careful system design has resulted in equipments which are lightweight and reliable, and the modular approach gives a flexible system which can be readily adapted to various weapon configurations.

Lightweight surveillance aerials are available to work with transmitter and signal processing equipments; they are designed to be mounted on a stable platform in a radome. The signal processing equipment includes digital doppler processing to give good performance in a cluttered environment.

The aerials can also be fed from a standard navigation radar. This dual purpose capability enables the weight on the masthead significantly

to be limited. One of these aerials, and the stable platform used, is shown in operation at the Marconi Radar Systems Stand at the Royal Naval Exhibition at Greenwich.

The accuracy of the surveillance radars and their display systems is such that they are suitable for the direct control of surface-to-surface missiles. Circuits can be included that give a target positional accuracy suitable for the engagement of a surface target by a medium calibre gun.

The tracker is a modern monopulse equipment and uses the same basic transmitter as the surveillance radar. Complete operation of target acquisition and tracking in both active and passive modes is fully automatic when once the target allocated decision has been taken; range accuracy and reaction times have been matched to the performance of modern weapons. Digital doppler processing equipment is fitted in all versions of the tracker in order to give good performance in cluttered conditions. Certain design features are also included for use in an electronic counter measures environment.

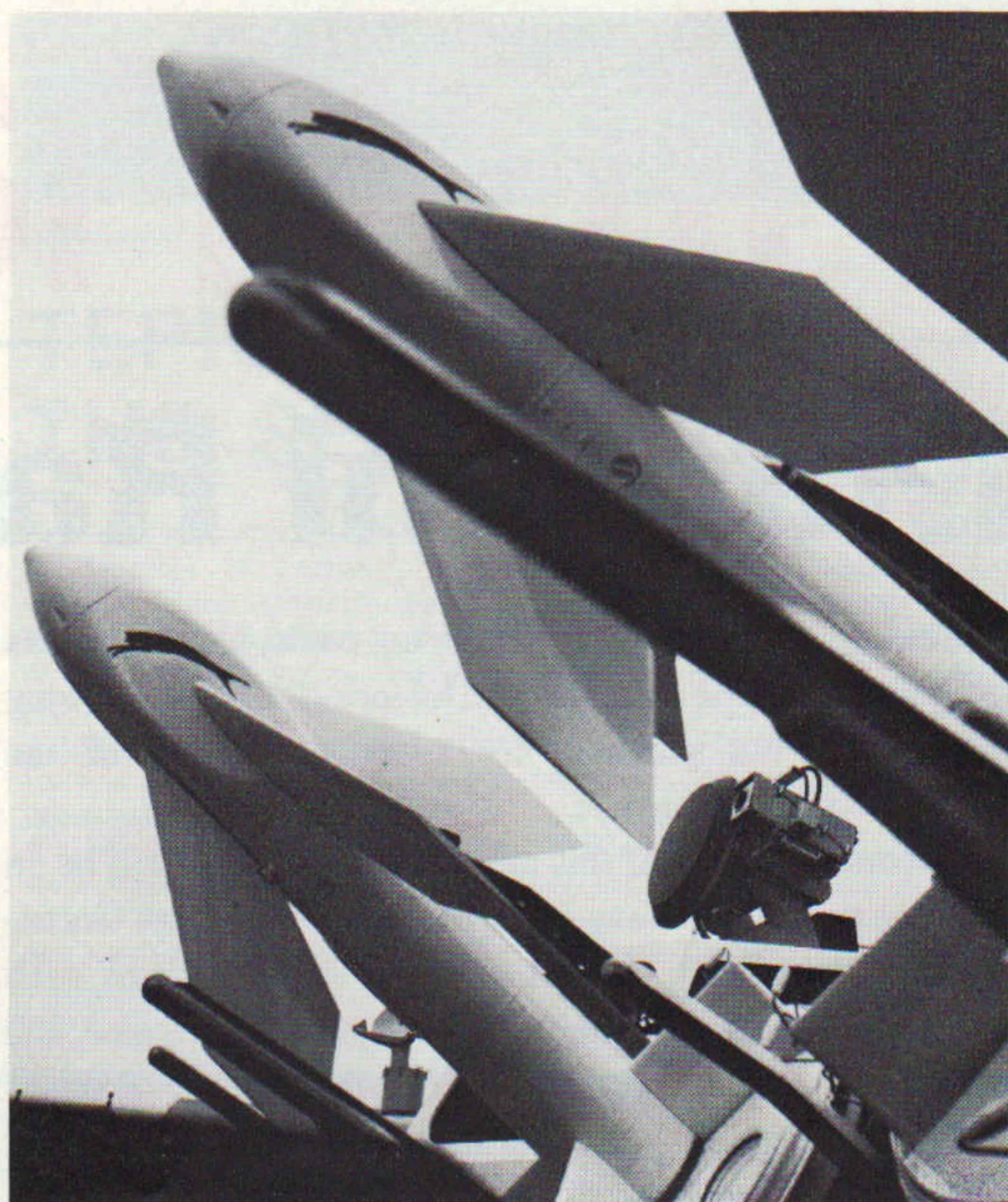
The tracker can be operated autonomously when fitted in a small ship or be driven from the central computing control equipment of larger warships. It can also be programmed to carry out its own search pattern and can either have targets allocated to it for the display position or be set to acquire and track the first target seen.

The equipment is lightweight and designed to meet the ship fitting needs of very small warships.

The tracking radars are designed to control command to line-of-sight type missiles, and guns used in defence against low flying strike aircraft. Action information offices and radar display equipment are provided for complete ship weapons system integration, threat assessment and weapon allocation purposes.

The number and types of displays, the track stores and the computer aids to the operator included with this system are dependent upon the weapon fit and the ship's operational role.

The 800 Series has been designed to the high engineering standards necessary to meet the environmental specifications demanded by the Royal Navy. It is now fully developed and available for early delivery.



Tracker radar showing the type of weapon with which it can be used

## NAVAL WEAPONS RADAR SYSTEMS

### Tracking Radar ST801

ST801 is a monopulse naval tracking radar with MTI for use as the auto tracking element in gunfire direction systems and in missile launching and guidance systems with automatic operation controlled by a central computer complex. For automatic control of command to line of sight missiles, a television channel is fitted.

### Tracking Radar ST802

ST802 is the autonomous version of the ST801 with the facilities necessary to allow it to function on its own, without the interface and control by a weapon system computer. The ST802 with a television camera aligned to the boresight provides independent control and 'dark-fire' for weapons such as Seacat.

### Surveillance Radar S810



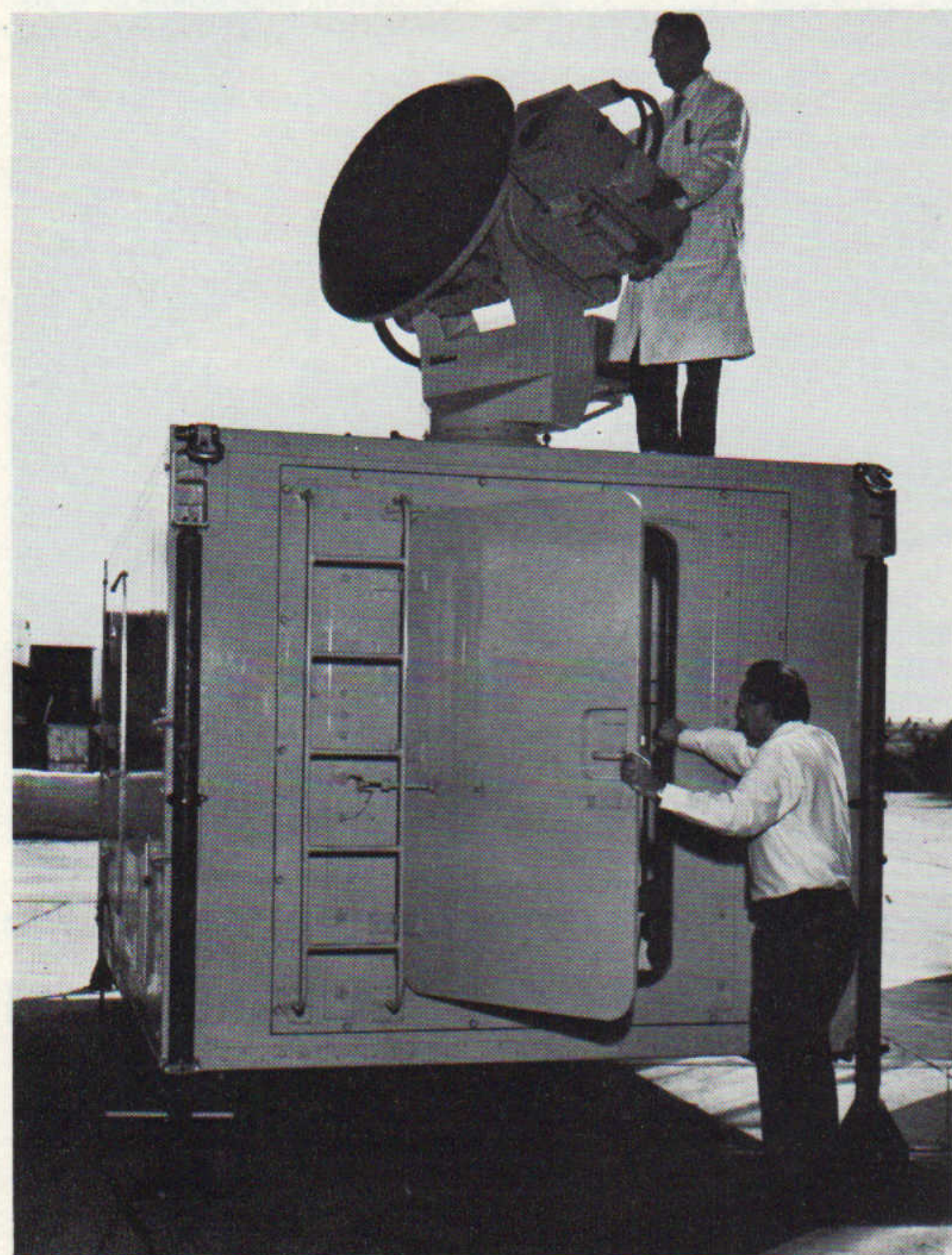
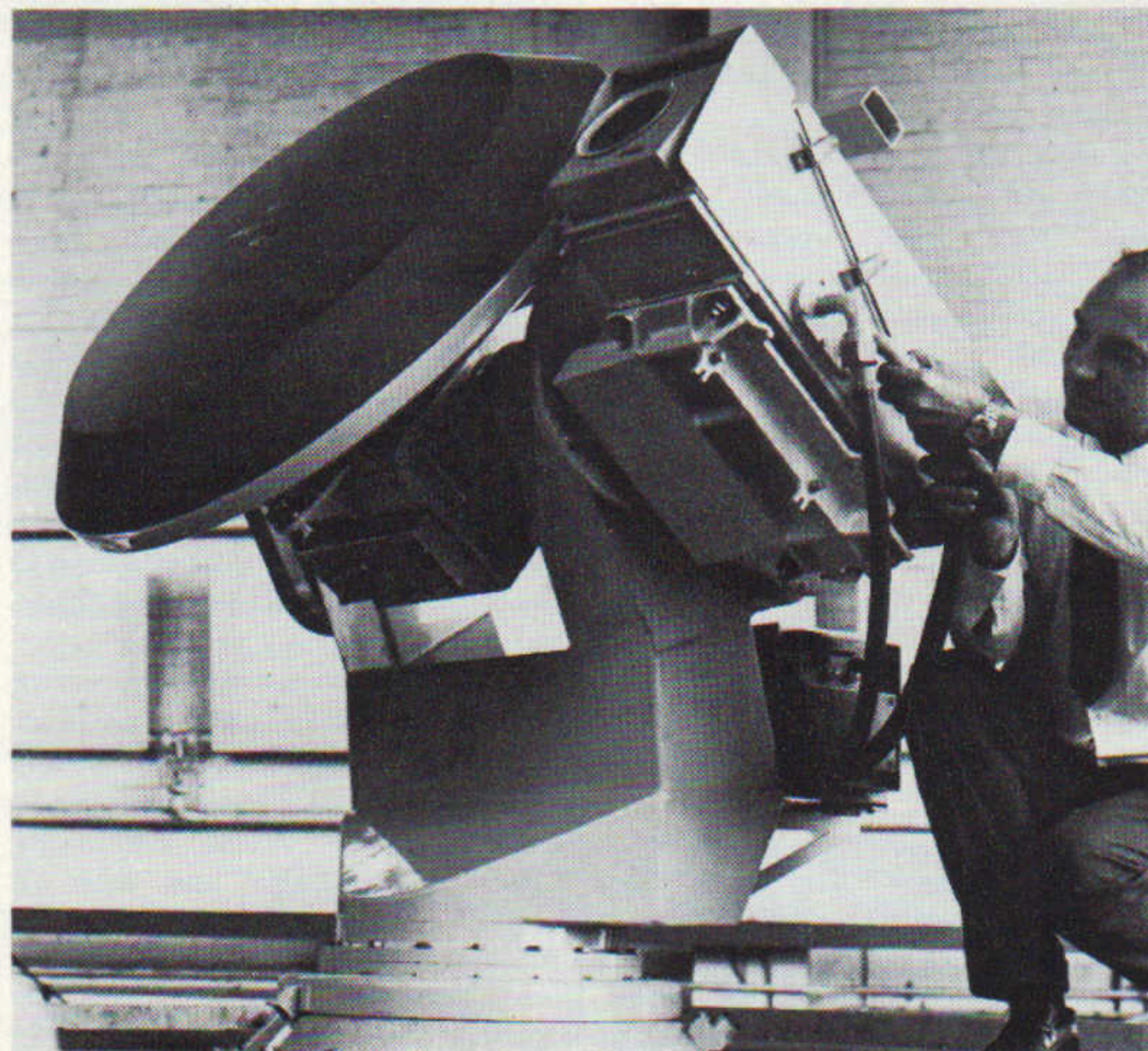
S810 is a stabilized naval surveillance radar with MTI. Its vertical cosec<sup>2</sup> beamshape ensures good coverage against air targets whilst the narrow horizontal beamwidth gives accurate target indication data for pointing weapons and putting on tracker radars. This radar can also be used for navigation.

### Surveillance Radar S811

S811 is similar to the S810, but without MTI signal processing.

S815 is similar to S810 except that it has a stabilized 2.5m (8ft 2½in) wide by 0.9m (3ft) high cosec<sup>2</sup> antenna mounted in a radome to increase the surveillance cover against air targets.

S816 is similar to S815 without the MTI signal processing.



ST801 and associated equipment in an Airtech cabin

## LAND-BASED WEAPON RADAR SYSTEMS

ST850 fire control unit is the radar and weapon control system which forms part of the TIGERCAT II missile system. It comprises a pulse-doppler tracker with MTI facilities, the Marconi television autogather system and weapon control consoles, all of which are fitted in an air-conditioned cabin.

ST851 is a fire control unit similar to the ST850, but is specifically de-

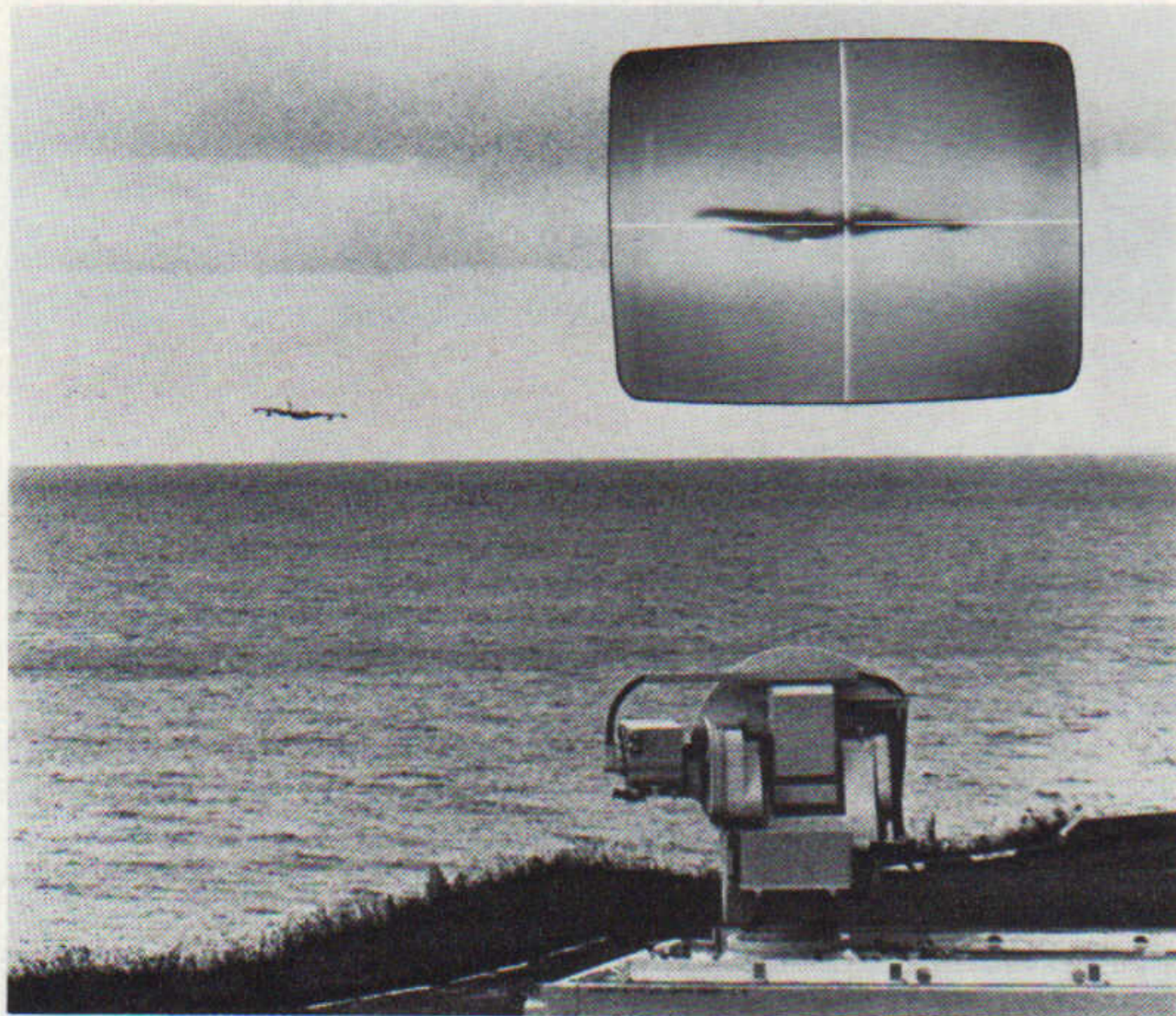
signed to automatically control up to four separate guns. It incorporates a digital prediction system to provide aim-off data and to automatically slew and control the guns.

S860 is a mobile surveillance radar, with MTI, using a 3.5m (8ft 2½in) wide by 0.9m (3ft) high cosec<sup>2</sup> aerial. The radar provides target indication data for point defence systems employing Tigercat missiles

or small calibre anti-aircraft guns. Two display consoles are included, one for target detection and tracking and the other for threat assessment, target allocation and weapon assignment.

S865 has similar characteristics to those of the S860 without the target indication displays. Instead, it provides outputs to drive the PPI display in the Type ST850 mobile cabin.

# Tracking radar put through its paces at Wembury



The tracker is locked on to a low flying aircraft and the inset picture of the TV monitor shows the target in the centre of the crosswires

Following the Farnborough success of their search tracker radar, ST801, the Marconi Radar Systems Company has recently carried out further performance trials at the Royal Navy gunnery range, HMS Cambridge, Wembury, near Plymouth.

The main purpose of the trials was to determine the suitability and performance of the equipments in a shipborne environment, and the ability of the outputs to control typical gun and missile systems.

The trials took place between the last week in May and the first week in July. Within three hours of its arrival on site the ST801 radar, which previously had been installed as an autonomous equipment in an Airtech air-conditioned cabin, was fully operational.

Tracking trials were carried out on balloon targets, surface targets travelling up to 35 knots and on air targets (Canberras and Hunters) at varying heights and aspects, including some very low level runs.

The radar also acquired and tracked 4.5in. shells travelling at 2,300 ft. per second. During flight the shells cannot be seen on the television screen and the success of

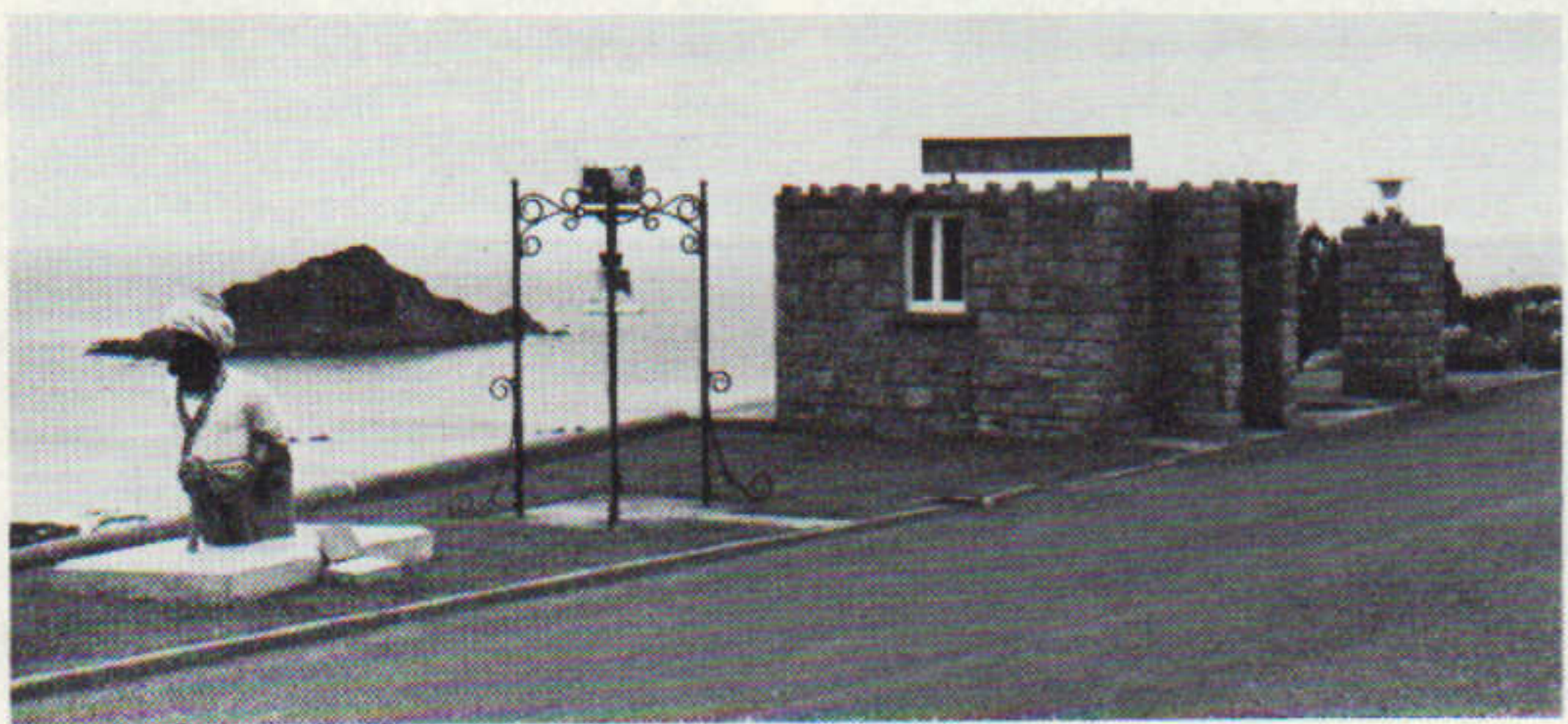
the track is determined by recording the shell-burst. Video-recorded frames show the shell-burst within the break at the centre of the crosswires representing an error of less than two minutes of arc.

Exhaustive mechanical tests were also applied to the ST801 equipment. The cabin was rocked to simulate ship movement and prove the line-of-sight stabilization circuits.

Throughout the whole six weeks of the trials, the ST801 radar continuously maintained its high level of operational efficiency. Its constant availability, its design quality, its reliability and ease of maintenance won great praise from the many observers and visitors who attended during the trials.

From the initial assessment and visual evidence there is every confidence that the equipment will be proved to meet its specification in every aspect, and in fact to exceed it in many ways.

The Marconi Company expresses its thanks to the Ministry of Defence (Navy) and to the Commanding Officer, HMS Cambridge, for their willing help and co-operation in the successful completion of these trials.



The gates of HMS Cambridge

## Marconi 800 series – the new radar generation – continued

### COASTAL DEFENCE RADAR SYSTEMS

S842 is a surface-surveillance radar which provides continuously updated accurate range and bearing data for weapon fire control systems. The system provides a detection range against a typical fast patrol boat in excess of 40km. A parabolic antenna rotated at 20 or 60 rev/min gives an azimuth beamwidth of 1.3°.

A target designation display console is provided with 4 auto-track channels and electronic marking.

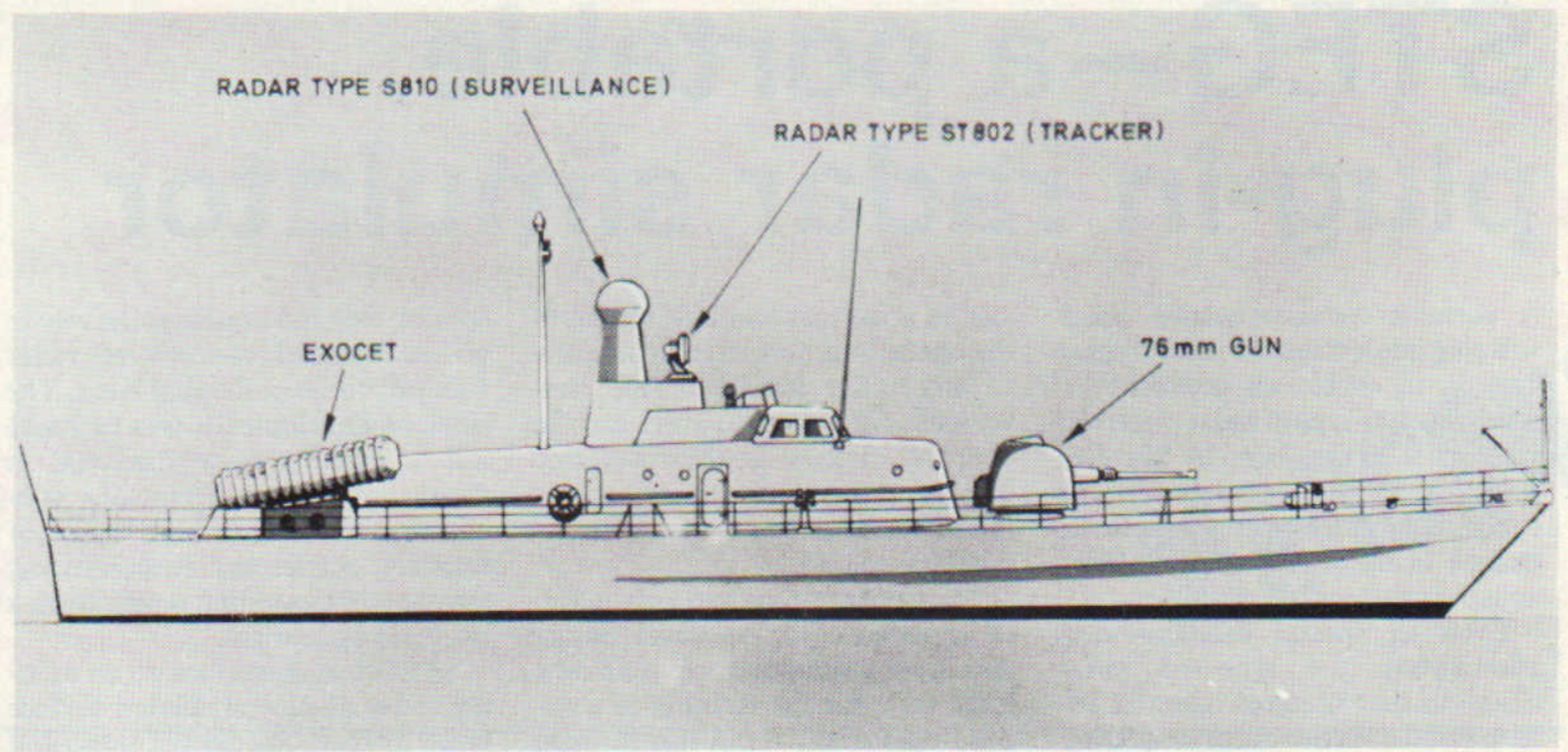
The system is designed to control the firing of surface-to-surface missiles, such as Exocet or Penguin, from shore batteries.

S844 is similar to the S842, but has a low-level air defence capability in addition to providing surface cover. In this, target data is extracted for passing to rapid-firing anti-aircraft guns.

In addition to linear and logarithmic processing, S844 has a digital MTI processor which facilitates the detection of low flying aircraft.

Two display consoles are fitted, one to deal with surface targets and one for air targets.

The system is designed to control the firing from shore batteries of surface-to-surface missiles such as Exocet or Penguin, and additionally, to feed air target data to a fire control



Outline drawing of a typical fast patrol boat

# FIRE CONTROL INSTALLATION FOR A SMALL WARSHIP

Today the fast patrol boat, armed with modern weapons and fitted with lightweight fire-control equipment carries the 'punch' of a major warship. Typical armament is a dual purpose gun, mounted forward, a command to line of sight (CLOS) surface-to-air missile mounted aft and a surface-to-surface sea-skimming missile mounted amidships. The armament provides two channels of fire against air targets to a range of 5km, a single channel of fire from a 3-inch gun for shore bombardment or against ships at 10km and a sea-skimmer range of 40km.

In the fast patrol boat, the surveillance radar and PPI display centre are of the conventional type, but the radars from the 800 series are light enough to allow the ship designer to mount the aerial equipment high on a mast to increase the radar horizon. Since there is only a limited space on the mast-head, the 800 series surveillance radars are designed to share their aerial with the navigation radar if required.

The standard fire-control system is made up of a tracking radar, a ballistic predictor and a gun controlled by electrical servos. The tracking radar defines the range, bearing and elevation of the target. The predictor calculates the aim-off of the gun. The gun itself is fired manually.

The light-weight Marconi tracking radar ST802 is the gunfire director designed to counter ECM and having pulse-doppler processing to reduce interference from sea clutter. This reduction of sea clutter is sufficient to destroy the natural cover on which hostile low-flying strike aircraft and sea-skimming missiles depend. The gun control system also requires measurements of the ship's roll and pitch, direction and speed. These are derived auto-

matically from the ship's vertical reference, compass and log. A typical fire-control system is shown in the accompanying diagram.

The main control centre in a fast patrol boat is the radar display console. This unit is made up of a PPI display of radar surveillance data, the tracking radar control and indicator units, together with the gun indication panels and firing units.

Only two men are necessary to man this fire control system to achieve rapid response to attack. One designates the target and the other controls the engagement.

For a surface-to-air missile such as Seacat, various systems are possible.

### VISUAL SYSTEM

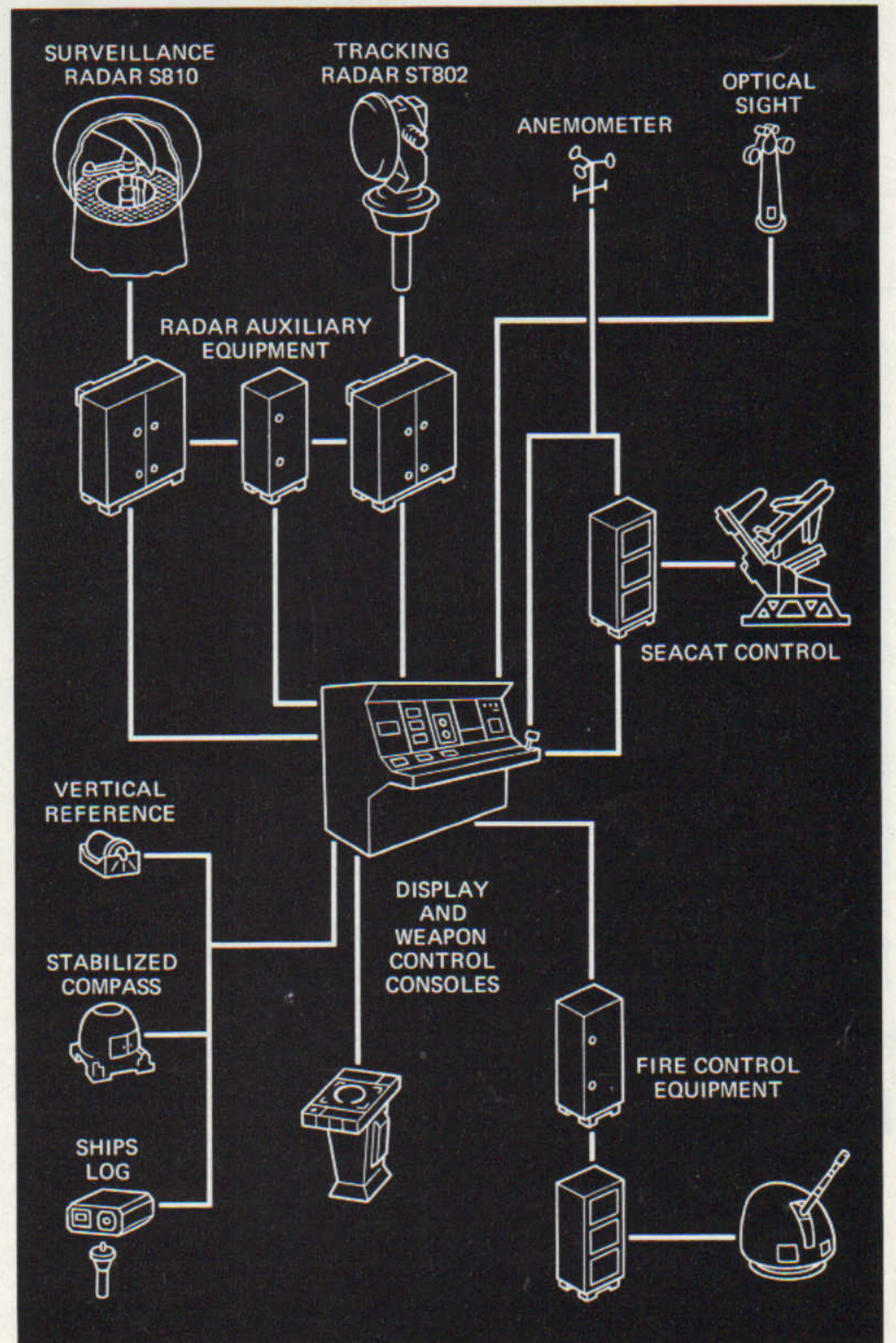
In the visual system, the operator on the bridge views the target through binoculars and uses a hand operated joystick to control the missile via a radio link until impact.

### TELEVISION-AIDED 'DARK FIRE' SYSTEM

In the 'Dark Fire' system, the operator is viewing a television monitor below decks, using radar to track the target and a television camera to track the flares on the missile in flight. The missile is automatically gathered by television and thereafter the missile flares are kept on the monitor crosswires by the use of a joystick. These crosswires are aligned with the radar to target line-of-sight. In centring the image of the flares the missile is automatically steered to impact.

During recent trials at Aberporth and Wembury the 'Dark Fire' system was proved able to be extended to give 'Blind Fire' capability for all weather conditions.

The radar ST802 is suitable for tracking in both 'Dark Fire' and 'Blind Fire' systems. In the 'Dark Fire' system the missile is tracked by the Marconi Television (MEAS) system, TV1000, mounted on the radar director.



A typical shipborne fire control system

### MOBILE AND STATIC EQUIPMENT

In all cases the equipment may be supplied for static installations or in a mobile cabin. Provision is made for standby equipments with inter-switching.

# STEG—a portable, plug-in radar simulator

A portable radar simulator which will plug into a standard radar display console to enable an instructor to reproduce any type of radar picture at will, has been developed by Marconi Radar Systems at Leicester. The equipment enables personnel to be trained in the use of radar in their actual operational surroundings.

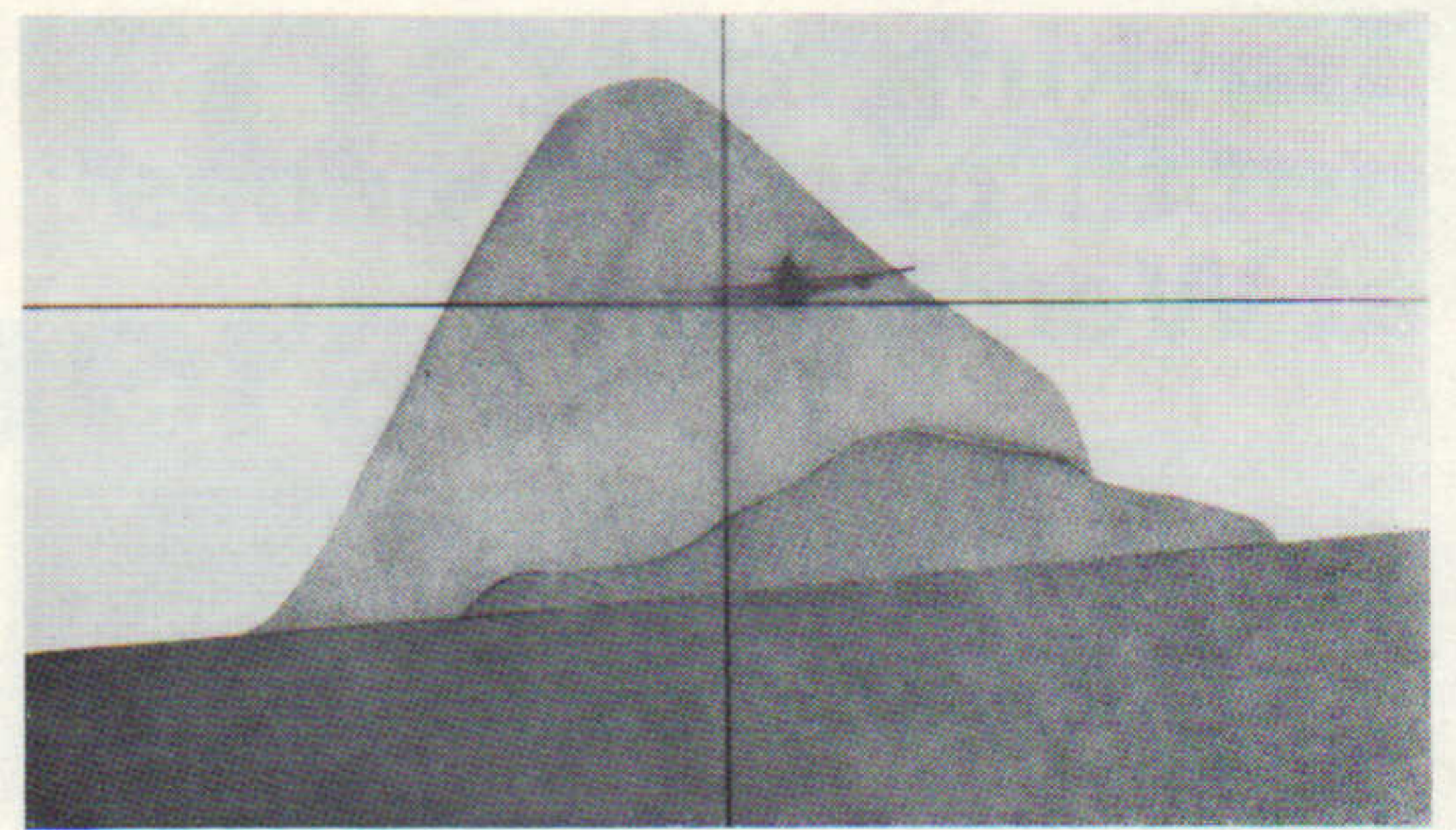
Even in special exercises and manoeuvres the type of radar situation that requires operator intervention does not occur frequently but with this new simulator, STEG (Simulated Timebase and Echo Generator), critical radar situations

can be generated and repeated until the operator is able to react skilfully to any radar incident. This convenient plug-in simulator can be coupled directly to Marconi 800 display systems, or to any other radar consoles via a small intermediate unit.

The Company has had a great deal of experience in the development and supply of simulators, often on a large scale for the training of complete operations room teams. Such simulators are usually in specially built fixed installations at training centres and, although highly suc-

cessful, they have pointed the way to an economical concept of radar training on an individual basis. The obvious development was to make use of existing radar consoles, in their normal environment, substituting for their normal inputs of timebase echoes and synchronizing signals corresponding inputs from a portable equipment.

STEG can reproduce on an existing radar display simulated surface craft, aircraft, sea clutter, noise and other special effects. Only very recently has the technology of semi-conductors permitted such a concept to be realized, by the use of miniature low cost devices capable of carrying out computing and memory functions. Many of the features of a large simulator can be incorporated in a portable instrument and as a result it has become feasible to deploy simulators at operational sites to be used at periods when the equipment is not required for its prime duty. In this way a large number of training positions are made available without moving manpower away from action stations.



A simulated television picture

## TEPIGEN TRAINS THE SEACAT AIMER

Dramatic new techniques developed by Marconi at Leicester, under contract to the Admiralty Surface Weapons Establishment have been directed to making a television picture generator (TEPIGEN) for training missile aimers who work from a TV picture. The picture presented by TEPIGEN moves as the line of sight changes, in the same way that a televised picture would, and the aircraft can carry out manoeuvres with the correct changes of aspect.

This new type of fully synthetic simulation has a wide range of application, wherever men have to be trained in a visual task. Simulators in current use produce pictures by viewing scale models with TV cameras. Where the model is extensive as for an airfield or harbour, a separate building may be required to house it. Clearly such a simulator is not mobile whereas a system based on TEPIGEN could be taken in a trailer to give training to units in the field.



An instructor uses a hand-held keyboard associated with STEG (bottom left) to generate radar pictures

## Old campaigner gets new deal

British Centurion tanks still form an important part of the defence equipment of many countries and, in spite of their age, have proved themselves more than a match for most other tanks in several engagements that have taken place over the past few years.

The cost of new main battle tanks is extremely high and many countries owning Centurions plan to extend the useful life of these well proved vehicles well into the 1980s by carrying out a modernization programme.

One feature of such a programme is the replacement of the obsolescent thermionic gun control equipment by a modern equivalent, and the Control Systems Department at Leicester has designed an advanced solid-state system that will considerably improve the gun's effectiveness.

Two versions of the equipment are available: Type GCE581 is designed to interface with the existing metadyne in Centurions, and Type GCE576 is designed to operate with a new and more powerful metadyne set, which gives faster turret accelerations and traversing rates.

Both equipments use solid-state circuitry throughout and give a significant improvement in stabilization accuracy over the previous thermionic equipment. Besides consuming less power, there is virtually no warm-up period and the drift during operation is very slight. Trials results on prototype systems show that the gun of a Centurion fitted with GCE576 equipment is kept on a circular target of diameter 2 mils for 55 per cent of the total time



Centurion undergoing trials at the Marconi, Leicester site

using steel tracks in dry conditions, and 40 per cent of the total time using rubber tracks in wet conditions, when the tank is moving over a cross-country course at 10 mph.

Provided that the vehicle has been reasonably well maintained, it is not necessary to carry out refurbishing work on the main traverse gear and gearbox, or on the gun elevation drive. The better the condition of the Centurion, the better will be the performance obtained, but the new Marconi equipment will give any Centurion vehicle a far better maintenance than can the existing equipment, with the additional advantages of greater reliability, easier performance, greater stabilization accuracy and significantly reduced drift.

In two recent additions to the Company's range of 400mm displays, the presentation of data in a form that can be more quickly and accurately understood has been achieved by the use of colour. These additions are the S3016 colour display, capable of presenting a radar picture in three colours, and the S3018 display which can superimpose 35mm film strip onto the screen by rear projection.

The S3016 display accepts alphanumeric labels and synthetic reference data but different classes of information can be presented in different colours. For instance, a distinction can be made between friendly and hostile aircraft, or between inbound and outbound aircraft. The use of colour in this way helps the operator to make a quick and accurate appraisal of a displayed situation.

The S3018 rear-port display is ideal for highlighting an aircraft echo in relationship to its environment. Full colour airways maps and procedural charts can be superimposed on live radar situations to give more detail than can be achieved even by costly and sophisticated computer-graphic techniques.

A selection from an extensive store of written instructions can be projected onto the screen during doubtful or emergency situations, without affecting the quality of the radar picture at a critical time. These are unique features which are available to the user.

Each display uses a special cathode-ray tube. The tube of the S3016 colour display has two separate phosphor layers laid one behind the other with a transparent barrier layer in between. Colour change is achieved by electrically switching the tube anode potential. This changes the electron beam velocity so that at the lowest value, the beam penetrates the barrier layer and the front phosphor predominates to give a green light. The amber colour is obtained at an intermediate value of beam velocity when the front phosphor is only partially excited.

The data capacity of the S3018 rear port display comes from an optical system carrying over 1,000 separate frames in a motorized 35mm film unit. The display tube phosphor layer is used as a rear projection screen and the multi-

colour images are projected through an optical port set into the cathode-ray tube cone. This is totally independent of any radar input to the display.

Both displays are housed in similar modular frameworks. They use the same deflection, video and power sub-units, and are interchangeable with the conventional S3017 analogue and S3015 digital displays. The features of a 15-microsecond settling time and a 2.0MHz bandwidth for the printed circuit and printed coil deflection system common to this series of displays have been retained and have already attracted favourable attention from various government and service establishments.

Both types of display have been sold for military and civil evaluation. The S3016 colour display has been sold to the Admiralty Surface Weapons Establishment at Portsmouth and to the Civil Aviation Authority's evaluation unit at Hurn. The CAA has also purchased three Marconi rear-port displays, Type S3018, one of which is currently being evaluated by the Royal Radar Establishment at Malvern.

## RADAR PEOPLE

PETER WAY is a director of Marconi Radar Systems Limited and General Manager of the Company's operations at Leicester. After serving an apprenticeship with English Electric and Marconi, he worked at the National Physical Laboratory on ACE, one of the very first electronic digital computers. He later joined the Baddow Research Group and his first major management responsibility was the co-ordination of the highly successful Swedish defence data handling system. He was subsequently responsible for the formation of the Marconi Automation Division, handling industrial contracts covering power distribution, traffic control systems and steel mills controls.

As a result of the formation of GEC-Marconi Electronics, he took up his present position at Leicester in 1969 when his infectious enthusiasm and proven ability quickly won him the respect of his new staff and colleagues. Under his leadership the Company at Leicester has been restructured to form a cohesive and highly successful organization handling important naval and other military contracts.

Peter Way's efforts in developing new markets for the Company have taken him to most countries in the world but when he is at his home in Oadby he enjoys working in his large garden and being with his family. He has a wide range of hobbies but claims that one of his best decisions



was to sell his golf clubs! One of his most recent pastimes is the cutting and polishing of semi-precious stones. This was inspired by the elder of his two daughters who is an art student at Loughborough College.