On Her Majesty's Service

PROFILE

The Newspaper of Royal Ordnance

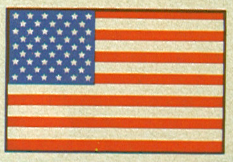
JANUARY 1985 No 51

35 years of NATO

1984 marked the 35th anniversary of the signing of the North Atlantic Treaty — the birth of NATO. For the longest period this century Western Europe has been at peace thanks to the existence of this Alliance.

Like other member nations Britain commits land, sea and air forces to NATO, and through them Royal Ordnance equipment plays an important role in Western defence. On pages 4 & 5 we examine the organisation of NATO and how its political and military structure functions.

ALSO IN THIS ISSUE: Restocking HMS Victory's ammunition — page 3; Apprentices' work on display, in colour — pages 6 & 7; Technical Fact File on plastics — pages 8 & 9; Victorian discourse on Enfield Rifle — pages 10 & 11.



Mortar deal is signed

Dr Jay R. Sculley, United States Assistant Secretary of the Army for Research, Development and Acquisition, signs the formal agreement for the 81mm mortar orderr. With him are Mr Adam Butler, British Minister for Defence Procurement, and Royal Ordnance Chairman Mr Fred Clarke. Below: Dr Scully gets to grips with the mortar as Mr Clarke looks on. Full story page 3.

WELCOME TO NEW COMPANY

History made as 1985 dawns

ROYAL ORDNANCE plc officially came into being on Wednesday, January 2. This was the awaited Vesting Day for which the firm date was announced in Parliament on Friday December 21.

On Vesting Day all the factories and establishments, including the agency factories Featherstone, Powfoot and Summerfield, became vested in the new public company.

Included in the property transferred were land, buildings, plant and machinery as well as current stocks, work in progress, cash and other financial assets of course, book debts and the benefit of agreements and contracts already entered into by, or on behalf of, the Royal Ordnance Factories organisation.

The instrument by which this complete transaction was made was the scheme formulated by the Secretary of State for Defence under the provisions of the Ordnance Factories and Military Services Act, 1984.

Certain legal requirements have to be met when setting up any new company and these involve registration of the company at Companies House in London. This step was taken in the middle of last year when documents were submitted to and accepted by the Companies Registrar. In simplest terms these detailed the name and structure of Royal Ordnance plc with its four subsidiaries: Royal Ordnance Ammunition Ltd; Royal Ordnance Small Arms Ltd; Royal Ordnance Weapons and Fighting Vehicles Ltd; and Royal Ordnance Explosives Ltd, as well as Royal Ordnance (Crown Service) Pension Scheme Trustees Ltd, and Royal Ordnance (1984) Pension Scheme Trustees Ltd.

Once Vesting Day was known and final requirements had been met the Companies Registrar issued a certificate which enabled the new company to commence business on the first working day of the New Year as the successor to Royal Ordnance Factories.

As payment for the transfer of all property and assets from the Ministry of Defence to Royal Ordnance plc, the company issued 60 million shares to the Secretary of State. For an initial period it will trade as a company wholly owned by the Government, during which time it is expected to act as a commercial company and take its own commercial decisions. While the Secretary of State will be kept informed of the company's activities and will need to approve business plans, he is not expected to have any involvement in the day-to-day operation.

In due course private capital will be introduced into the new organisation and it is expected that this will be achieved by offering for sale to the public shares in the company. At this stage, of course, it is not known for certain when this might happen, but it is unlikely to be before the middle of 1986.

The current situation is such that Royal Ordnance wholly owns shares in the subsidiary companies. Four of them, created from the new divisional structure established last spring, manage their respective divisions of the business, acting solely as agents of Royal Ordnance and do not actually own any assets or property themselves. The remaining two companies will not trade at all because their purpose is solely to manage the company pension schemes.

As Vesting Day dawned employees of the former organisation ceased to be civil servants and became employees of the new company, with the exception of those who remain temporarily on secondment from MOD.

Message from the Chairman

To mark Vesting Day and the birth of the new company our Chairman, Mr Fred Clarke sent the following message to all Royal Ordnance employees, through respective directors:

" First of all, may I wish you a Happy New Year. It is, of course, a special one for us all as today our organisation has been incorporated as Royal Ordnance plc.

Our future prosperity depends on how everyone pulls together in sales and marketing, research and development, manufacturing, and in all the support functions to ensure the success of the new organisation. I am confident that I can count on the support of everyone in the years ahead."

Fred Clarke

Congratulations!

Miss Pauline Winks, Personnel Manager of Royal Ordnance, the holding company, was made MBE in the Queen's New Year Honours List. Pauline, who joined the Civil Service in 1940, was, before taking up her present post, a senior executive officer with OF/Personnel 3/5.

Also cited in the Honours List was Mr Donald Lingley who receives the Imperial Service Order. Donald retired as Manager Quality at Patricroft last year but has since returned on a part-time basis.

173 YEARS SERVICE MARKED

Five members of the Westcott workforce have clocked up a total of 173 years' service and to mark the event they were presented with Imperial Service Medals by Mr Harold Williams, Director of the establishment. Pictured here with Mr Williams (seated front row) they are: standing left to right — Mr A. V. Greagg, chargehand craftsman whose record is 29 years; Mr D. T. Bates, craftsman with 36 years; Mr F. Cook, a driver with 38 years. Seated, left, is Mr E. Corcoran, craftsman with 33 years' service, and right, Mr A. W. Beattie, a chargehand driver with 37 years.

Sparky hands Oracle ISM then gives him the golden numbers before going 10/10!

When the time came for Blackburn's Director Dave Walton to present the Imperial Service Medal to Bill Stalker he discovered that they shared the same interest — as CB enthusiasts.

Sparky is Dave Walton's call sign, or handle in Citizen's Band parlance, while Bill's is Oracle.

So, as colleagues gathered for the ceremony Sparky presented the well deserved medal to good buddy Oracle then gave him the "golden numbers". That's best wishes, for the non-initiated. 10/10? — well, that's standard speech for end of transmission!

Bill Stalker is now retired, having worked at Blackburn as a storekeeper. He moved to the factory in 1958. He began his career in 1942 joining what was then Royal Ordnance Factory Maltby as a lad. He became a labourer in 1946 and a storeman in 1954.

Christmas greetings ... by kissogram!

Glascoed Development Manager Fred Dobb got an extra Christmas present from registry girl Mandy Davies — a 'Kissogram'! But why Fred? To which Mandy replied — "Why not!"

Photograph by Bryan Morgan

Well done ladies and gentlemen of Chorley who have gained a major national education certificate in supervisory studies.

A total of 16 students from all areas of work within the factory complex passed the examination at the end of the 1983/84 academic year and have now been presented with their NEBSS certificates by Trevor Colyer, Chorley Production Manager. The course was run at the factory Training Centre and tutored by Wigan Technical College staff.

Trevor Collyer, tutors and Training Centre staff joined the successful 16 for this commemorative photograph. On the extreme left is Chorley's Chief Training Officer, Stan Taylor.

Canteen cheer ...

It's not often that canteen staff enjoy the publicity so Bryan Morgan at Glascoed decided to redress the balance when he took this photograph of some of those who keep the factory's employees nourished throughout the year. Here enjoying the Christmas festivities are: (l to r) Vi Prince (Supervisor); Sandra Gameson (Assistant Manager); Roger Williams (Manager); Julie Porter and Hilda Waddington (Supervisor).

PROFILE

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USA is 38th country to buy the 81mm mortar

WORTH £2.1 million, the initial order for the 81mm mortar for the United States Army, signed just before Christmas, paves the way for future sales to the USA which could total several hundred million pounds.

The initial contract covers a pilot production batch of mortars and several thousand mortar bombs and makes the United States the 38th overseas country to buy the weapon. In the form of a formal agreement the document was signed at the Ministry of Defence headquarters in Whitehall last month by Mr Adam Butler, Minister for Defence Procurement, and Dr Jay R. Sculley, US Assistant Secretary of the Army for Research, Development and Acquisition, in the presence of Royal Ordnance Chairman Mr Fred Clarke, and Managing Director Mr Bill Meakin.

For US use the mortar has been refined under a joint development contract and this version can be distinguished immediately from that in British Service by a widening at the muzzle end. In addition to having been accepted by the US Army it is also being looked at by the US Marines.

Speaking at the signing ceremony, Mr Butler said the agreement was a fine example of the co-operation between the two countries in the defence field and proof of the "two-way street" that operates. It was, he said, one of a recent line of orders placed with Britain by US Defence Forces who have acknowledged the quality of our equipment.

Dr Sculley pointed out that the American Army had identified the mortar in the late Seventies as the system which promised to meet their requirements. The signing ceremony was therefore an historic occasion — the culmination of a lot of hard work by dedicated people.

He went on to stress the importance of the partnership of Britain and the USA in NATO which, he said, was the best example of political and military alliance. "The production contract for the 81mm mortar reaffirms our commitment," he continued, "and we look forward to additional successes as we work together for a stronger alliance."

The 81mm mortar is an important piece of equipment in the British Forces' inventory. Exhaustively proven in combat, it is highly accurate and has a high rate of fire which can be sustained at 15 rounds a minute in the extreme heat of operations.

Despite its strength and firepower it is lightweight at less than 40 kilograms and breaks down into three own-man loads for easy transportation.

Its range is from 100 to 5650 metres so it can be used for tasks that would otherwise require the use of field artillery.

The body of the high explosive mortar bomb is made from cast iron and specially designed to burst into a number of small fragments, each with lethal capability.

The mortar can withstand very high temperatures. Its L16A2 barrel, made from nickel-chrome alloy, has cooling fins to dissipate heat and enable it to withstand prolonged firing at maximum charge.

As well as being fired from the ground the mortar can be mounted in and fired from an armoured personnel carrier. This enhances its considerable versatility, and is well used by British Army units who take full advantage of being able to change a mortar location and put the weapon into action in the fastest response time.

The mortar was well to the fore in last September's giant exercise Lionheart 84 in Germany, as reported in PROFILE. It played an important role in sustained defence against advancing Orange ("enemy") forces and in the counter-offensive to neutralise Orange gun positions, for instance, and so support the advance of Blue Forces.

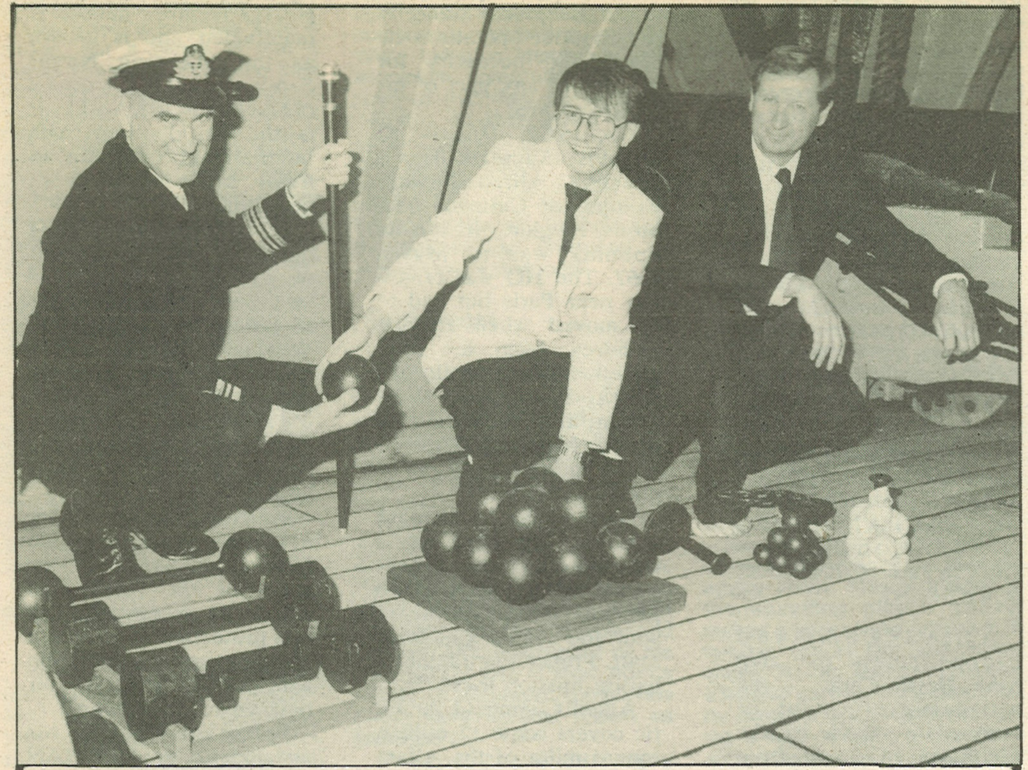
Mortar fire is a very effective form of bombardment. A single mortar unit, located in natural concealment and with a judiciously sited forward observation and control post, can pin down and inflict considerable damage on enemy positions. It is equally effective in both defensive and offensive roles.

Prior to an advance both artillery and mortar fire are brought down on enemy concentrations. As the advance proceeds and points of stubborn resistance are encountered, friendly forces are too close to the enemy for artillery support to be called for. Here the mortar comes into its own again to take out those strong points and clear the way for the infantry.

The principle of the modern mortar made its debut in the First World War and subsequent development produced a range of such weapons deployed by all belligerent nations in the Second World War.

The Royal Ordnance 81mm mortar came on the scene in 1960 and with continuing refinements has become the world's most efficient medium mortar system. This fact has been borne out by the one true test in real battle — it was fully proven during the Falklands conflict.

More ammunition for Nelson's flagship



Although more used to producing sophisticated 20th Century weapons systems, Royal Ordnance came to the rescue when the world's most famous warship, *HMS Victory*, needed to replenish her stocks of ammunition of the Napoleonic period.

When the order for round shot, bar shot, chain shot and grape shot arrived the work was given to third year apprentices at Patricroft.

They stepped back in time to the skills of almost two centuries ago and produced the ammunition using mainly scrap cast iron and steel, giving the finished products an antiquated appearance by shot blasting.

The completed order was delivered to *HMS Victory's* Commanding Officer, Lt-Cdr Charles Addis, last month and he is pictured here with Patricroft's Director, Bill Turner, and 19-year-old John Bough, one of the apprentices involved.

On the extreme left (foreground) are three types of bar shot, then the round shot (cannonballs), and next comes the grape shot displayed separately with propelling spigot and complete inside the muslin bag. Behind these is an example of chain shot.

ROYAL ORDNANCE BOARD

As Royal Ordnance plc began trading as a public company on January 2 the full list of members of the Board, as approved by the Secretary of State for Defence, was published.

They are:

Mr F Clarke, Chairman and Chief Executive
Mr W Meakin CB, Deputy Chairman and Managing Director
Mr N A C Bell, Finance Director
Mr C H Henn, Director Organisation and Planning
Mr T H Kerr CB, Director Research and Development
Mr T P McLoughlin, Sales and Marketing Director
Mr A J Reed, Personnel Director
Mr H Butterworth, Divisional Managing Director Ammunition Division
Mr S Carroll, Divisional Managing Director, Small Arms Division
Mr R L Goldsmith, Divisional Managing Director Weapons and Fighting Vehicles Division
Mr T Truman, Divisional Managing Director Explosives Division
Mr B R Basset
Mr E J Challis OBE
Sir Arnold Hall
The Rt Hon the Lord King of Wartnaby
Air Chief Marshal Sir Douglas Lowe GCB, DFC, AFC
Mr J K Stuart

● Mr Challis, Sir Douglas Lowe and Mr Stuart were formerly non-executive directors of the Royal Ordnance Factories organisation within MOD.

PERSONNEL UPDATE

Two new appointments have been made in Personnel since publication of the last update. Peter Woodhall has left Organisation and Planning to become Assistant Director, Employee Relations 1, a department which principally specialises in matters concerning weekly paid employees, and barrister Jane O'Rourke has also joined the Personnel Department.

On December 17, another meeting of the Parallel Working Group took place (Trade Union/Official Sides), under the Chairmanship of Mr John Reed, Personnel Director. First item on the Agenda was the Employees Handbook, and it was reported that, subject to minor changes, agreement with the Trade Unions is now imminent. Neither side of the Working Group felt there were any insurmountable obstacles to be overcome.

There was nothing new to report on security guarding arrangements. The meeting was advised that proposals for new joint consultative machinery would be available shortly. There was little to report that was new for procedures dealing with disciplinary and inefficiency cases and grading structure for Non-Industrial staff. More definite news will be given as soon as possible.

Roger Shirley Assistant Director Employee Relations II (formerly Head of OF/Personnel 2) reported that a paper outlining the Company's policy, for career development had just been circulated to the Non-Industrial Trade Unions. He announced that further meetings of the Joint Working Party would be arranged to discuss the subject in conjunction with earlier proposals on future Personnel Management of Non-Industrials. Early resolution of remaining problems was hoped for.

REDUNDANCIES

As a result of increased orders at Birtley and Bishopton the number of redundancies announced in November at the two factories was reduced.

By the end of 1984 the pre-redundancy measures had been completed for all the surplus non-industrial personnel at the four factories and reductions will be achieved with no compulsory redundancies. The phased reduction of 1,017 industrial personnel continues.

Skills go on display

Graham Jefferson of Birtley received a merit award in the Mechanical Test section of the Tom Nevard Competition, while David Pipkin of Bridgwater earned a merit award in the Carpentry and Joinery section. Their presentations were made last month in the MOD Apprentice Awards Ceremony in London by Mr Tom King, Secretary of State for Employment. A third merit winner, Andrew Shaw of Radway Green receives his award at the factory where he works.

An impressive display of work by Royal Ordnance apprentices was a feature of a special exhibition staged in conjunction with the ceremony. It included a beautiful, fully working model of a Midland Railway steam loco, the "Princess of Wales," at five-inch gauge track scale, made by lads at Chorley. There was also a sectionalised model of a Mk V Centurion tank — a scale version of the actual tank that Leeds apprentices have refurbished for the Tank Museum at Bovington.

Service to the community was represented by a special vehicle designed and built by Leeds apprentices for a nine-year-old girl who is completely immobilised by Dystonic Cerebral Palsy. Thanks to their ingenious device which gives her the support she cannot achieve on her own, she now has full mobility and is proud of the degree of independence this has given her.

Another example of community service is the Harrington Rod made by apprentices at Radway Green. It is designed for surgical implant and fixture to the spine of a patient suffering from Scoliosis — an abnormal spinal curvature. The rod is intended to apply corrective force to the spine, hopefully to straighten it over several years.

Full colour pictures of a selection of the displayed apprentice projects appear on pages 6 & 7.

Last year marked the 35th anniversary of the formation of NATO, the alliance which has maintained peace and security in Europe for the longest period this century. Equipment manufactured by Royal Ordnance plays a vital role in NATO's front line where it is deployed by Britain's Armed Forces. While we come into regular contact with aspects and elements of NATO through the Forces we supply, we do not necessarily obtain a clear overall picture of the complex infrastructure and command breakdown of the Alliance. This special PROFILE briefing, therefore, has been prepared by the Editor as an insight into the organisation that safeguards the integrity of the North Atlantic area . . .

35 YEARS OF PEACE

Guide to the structure of 16-nation alliance . . .

World map showing the member nations of NATO and hence the area of interest covered by the Alliance. The geography clearly points to the importance of securing the ocean areas. The NATO countries are: 1 — USA; 2 — Canada; 3 — Great Britain; 4 — Iceland; 5 — Norway; 6 — Denmark; 7 — West Germany; 8 — Netherlands; 9 — Belgium; 10 — France; 11 — Luxembourg; 12 — Spain; 13 — Portugal; 14 — Italy; 15 — Greece; 16 — Turkey.

ON April 4, 1949, in Washington, 12 nations forged themselves into an alliance for collective defence by signing the North Atlantic Treaty. Thus was created NATO — the North Atlantic Treaty Organisation — which has secured peace in Europe for 35 years.

The founder member nations were: the United States of America, Great Britain, Canada, France, Belgium, Denmark, Iceland, Italy, Luxembourg, the Netherlands, Norway, and Portugal. Since then membership has grown to 16. Greece and Turkey joined in October 1951, The Federal Republic of Germany in May 1955, and the most recent incorporation was that of Spain in May 1982.

Territorial adventurism has no place in the aims and aspirations of NATO. It is a defensive alliance dedicated to preventing aggression or repelling it, should it occur. The signing of the Treaty and the posture adopted by NATO ever since have shown that an attack on any member nation is considered an attack on NATO as a whole.

The policy of the North Atlantic Alliance is based therefore on defence and genuine detente. NATO seeks a constructive East-West relationship through dialogue and mutually advantageous co-operation, including efforts to reach agreement on equitable and verifiable arms limitations.

But aggressioan is not prevented by words on paper alone, nor by extending the hand of friendship. A strong and effective defence provided by maintaining well equipped military forces in sufficient numbers is indispensable in the quest for greater East-West stability. This defence capability must be highly visible in order to pursue with continued success the long-standing policy of deterrence. Not only must NATO have sharp teeth, it must also be seen to have them and be ready to bite back if bitten.

Through this deterrent stance it is made clear to a potential aggressor that if he should initiate an attack he would be taking a risk out of all proportion to any advantage he might hope to gain.

NATO's strategy is one of flexible response in which it would be able to react to any level of attack, be it conventional or nuclear.

The forces of the Alliance comprise three interlocking elements known as the NATO Triad, which is made up thus:

- Conventional forces in sufficient strength to resist and repel a conventional attack on a limited scale and sustain defence in the forward areas against large-scale aggression.
- Intermediate and short range nuclear forces to enhance the deterrent and the defensive effort of conventional forces if necessary. These nuclear forces are, of course, a deterrence and defence against attack with nuclear weapons of similar kind.
- Strategic nuclear forces of the United States and United Kingdom, providing the ultimate deterrent.

The composition of NATO is a blended civil and military structure. Highest decision-making body and forum for consultations is the North Atlantic Council, composed of representatives of the 16 member countries.

At the Council's Ministerial meetings (twice a year) member nations are represented by their foreign ministers. The Council also meets occasionally at Heads of State and Government level. In permanent session, at ambassador level, meetings are usually weekly.

The Council's Defence Planning Committee comprises representatives of the member countries participating in NATO's integrated military structure and deals with matters specifically defence-related. It also meets in permanent session at ambassador level (countries represented by defence ministers). Both Council and Defence Planning Committee meetings are chaired by NATO's Secretary General, Lord Carrington, who succeeded Dr Joseph Luns last year.

Under the Council comes a group of committees covering such subjects as: political affairs, science, defence review, armaments, nuclear planning, civil emergency planning, air defence, economics, budget and communications, among others.

These committees are supported by an international staff provided from all member nations, and responsible to the Secretary General who, himself, is responsible for promoting and directing the process of consultation within the Alliance.

Highest military authority in NATO is the Military Committee composed of Chiefs of Staff of all member countries except France and Iceland. France, which is represented by the Chief of the French Military Mission to the committee, withdrew from the integrated military structure in 1966. Iceland has no military forces and is represented by a civilian.

The Chiefs of Staff meet at least twice a year, but for continuous functioning of the committee they each appoint a permanent military representative. The Military Committee is responsible for making recommendations to the Council and Defence Planning Committee on measures thought necessary for the common defence of the NATO area, and for supplying guidance on military matters to the major NATO commanders. Presidency of the Military Committee rotates annually among member nations, while its Chairman is selected every three years by the Chiefs of Staff. The Chairman represents the Committee on the North Atlantic Council.

The executive agency and support facility for the Military Committee is the International Military Staff (IMS) which ensures committee policies and decisions are implemented. The IMS is structured in divisions, with individual responsibilities covering operations, intelligence, logistics, command control and communications, armaments, standardisation and interoperability.

NATO's strategic area is divided among three commands: Allied Command Europe (ACE); Allied Command Atlantic (ACLANT); and Allied Command Channel (ACCHAN). Respectively, these are under the authority of: Supreme Allied Commander Europe (SACEUR); Supreme Allied Commander Atlantic (SACLANT); and Allied Commander-in-Chief Channel (CINCHAN).

Allied Command Europe covers the area from North Cape — the northernmost point of Norway — down to the Mediterranean, and from the Atlantic to Turkey's eastern border. It excludes Britain and Portugal because the defence of these two countries does not fall under any single NATO command.

Main functions of SACEUR in peacetime are preparation and finalisation of defence plans for his command area. He also recommends to the Military Committee measures likely to improve his organisation. He also schedules regular training exercises of which the big autumn manoeuvres are a prime example.

Wartime role of SACEUR would be control of land, sea and air operations in the ACE area. Internal defence and that of coastal waters would remain the responsiblity of the nations concerned, but SACEUR would have full authority to carry out operations he considered necessary for defence of any part of his command area.

The ACE HQ is at SHAPE (Supreme Headquarters Allied Powers Europe) at Casteau, near Mons, Belgium. Its official opening was in March 1967. The HQ was originally near Paris but had to be moved when France withdrew from the integrated military structure the previous year.

Similarly NATO HQ itself is located at Brussels. It too had to move from its previous Paris site.

Each of the 14 member nations maintains a national military representative at SHAPE to provide military liaison with the Allied Chiefs of Staff. France has a military liaison mission there.

Allied Command Atlantic covers some 12 million square miles of the Atlantic Ocean, extending from the North Pole to the Tropic of Cancer, and from the coastal waters of North America to the coasts of Europe and Africa (except for the Channel and British Isles).

The Supreme Allied Commander (SACLANT) is responsible in peacetime for preparing defence plans, conducting joint naval exercies, establishing training standards and supplying NATO authorities with information on his strategic requirements.

His major war task is to provide for the security of the Atlantic area by gaurding sea lanes and denying their use to an enemy. This, of course, is essential in safeguarding the reinforcement and resupply of Europe.

A permanent force of ships from the navies of NATO member nations is maintained and is known as the Standing Naval Force Atlantic (STANAVFORLANT). It is the world's first such international squadron to have been formed in peacetime.

In addition, for training purposes, and in the event of war, forces earmarked by the nations involved are assigned to SACLANT. While predominantly naval, these include ground forces and land-based air forces. ACLANT's headquarters are in Norfolk, Virginia, USA.

Allied Command Channel covers the English Channel, plus the southern areas of the North Sea where its role is control and protection of merchant shipping and co-operation with SACEUR in the air defence of the Channel.

Forces earmarked for assignment to ACCHAN are chiefly naval but they also include maritime air forces. Under CINCHAN's authority is the NATO Standing Naval Force Channel (STANAVFORCHAN) — a permanent force of nine counter-measure ships from various member nations' navies. Headquarters of ACCHAN are located in the UK at Northwood.

As outlined in the table, the three major NATO Commands are subdivided into a number of subordinate commands. Turning first to Allied Command Europe, there are five sub-divisions. Allied Forces Northern Europe (AFNORTH),

THROUGH NATO

with HQ at Kolsas, Norway, comprises Allied Forces North Norway, Allied Forces South Norway and Allied Forces Baltic Approaches.

Allied Forces Central Europe (AFCENT), based on Brunssum, Netherlands, is composed of: Northern Army Group, Central Army Group, Allied Air Forces Central Europe, and 2nd and 4th Allied Tactical Air Forces (2 ATAF and 4 ATAF).

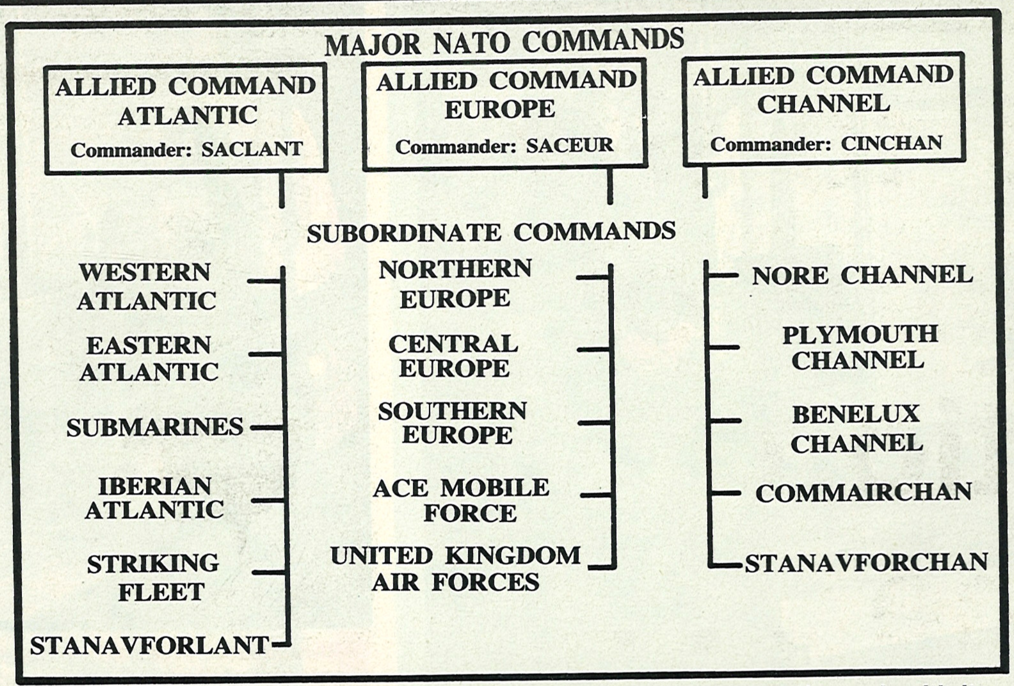
Based on Naples, Allied Forces Southern Europe (AFSOUTH) comprises Allied Land Forces Southern Europe, Allied Land Forces South Eastern Europe, Allied Air Forces Southern Europe, Allied Naval Forces Southern Europe, and Naval Striking and Support Forces Southern Europe.

The UK Air Forces Command (UKAIR) is based at High Wycombe, the headquarters of RAF Strike Command, whose C-in-C also commands UKAIR.

Allied Command Europe Mobile Force (AMF), which has its HQ at Seckinheim, W. Germany, is composed of land and air force units supplied by various member countries. It can be ready for action at very short notice in any threatened area of ACE, particularly on the northern and southern flanks. The land element of AMF was the subject of a special feature in an earlier issue of PROFILE.

A sixth command is the NATO Airborne Early Warning and Control Force which is under the operational command jointly of SACEUR, SACLANT and CINCHAN, with SACEUR acting as their Executive Agent.

In ACLANT, Western Atlantic Command (HQ Norfolk, Virginia) comprises the Submarine Force



How the NATO area of operations is divided into major commands, each with its own sub-divisions. Elements which comprise these subordinate commands are explained in the text.

Western Atlantic Area; Ocean Sub-Area; Canadian Atlantic Sub-Area; and the Bermuda, Azores and Greenland Island Commands.

Eastern Atlantic (HQ Northwood, UK) is further broken down into: Maritime Air Eastern Atlantic Area; Northern and Central Sub-Areas; Maritime Air Northern and Central Sub-Areas; Submarine Force Eastern Atlantic; and the Island Commanders of Iceland and the Faeroes.

The Striking Fleet Atlantic Command (HQ afloat) has a Carrier Striking Force and the Carrier Striking Groups 1 and 2.

Self explanatory are the Submarines Allied Command Atlantic (HQ Norfolk, Virginia) and the Iberian Atlantic Command (HQ Lisbon, Portugal) which also includes the Island Command of Madeira. STANAVFORLANT (HQ afloat) we have already covered.

In ACCHAN, Nore Channel Command has its HQ at Rosyth, Scotland; Plymouth Channel at Plymouth; Benelux Channel at Walcheren, Netherlands; and Allied Maritime Air Force Channel Command (COMMAIRCHAN) at Northwood. STANAVFORCHAN is, of course, commanded afloat.

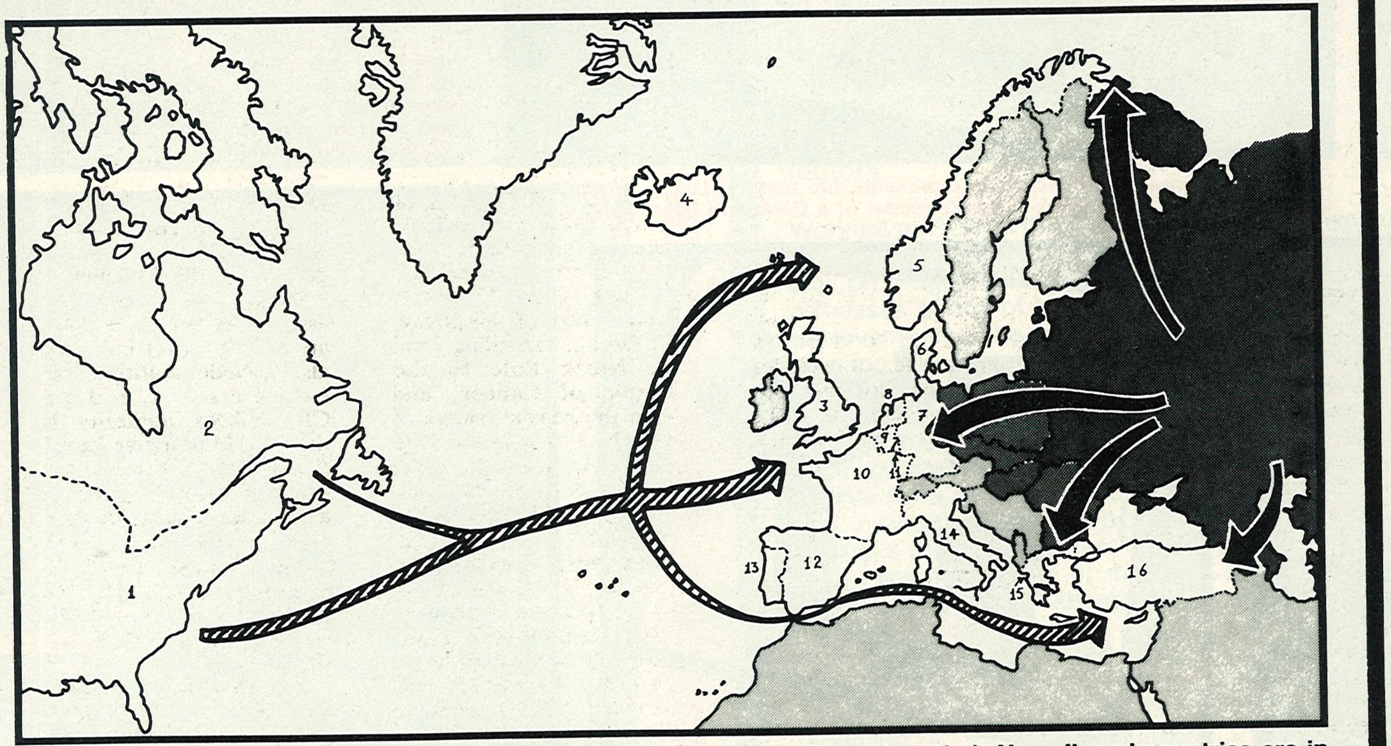
NATO is far more complex than can be detailed in the limited space available here. In addition to providing an effective defence of the West it plays an active role in the political sphere. Through the Alliance member countries exchange information and views, not only on issues directly affecting NATO, but also on matters that touch on the interests of individual member states.

This is not a unique situation, but this multilateral consultation, which was given impetus by the 1956 Report on Non-Military Co-operation, made the Alliance a forerunner in the field.

In addition to the political sphere NATO provides an excellent facility for international co-operation in science and technology in non-military as well as military fields. A prime example of the support given is furtherance of scientific knowledge of the world's climatic and marine conditions.

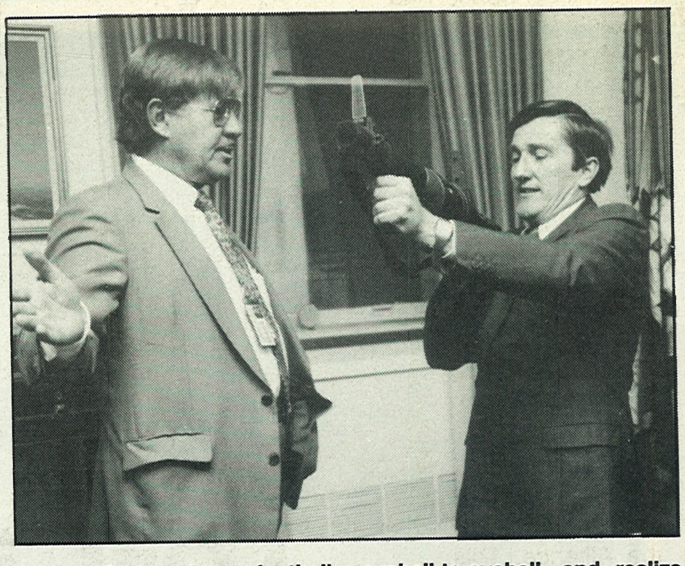
Initiatives in numerous fields have achieved success, notably environmental pollution, urban problems, use of energy and dangers affecting health and safety.

From all this it is obvious that NATO is effective not only in defending our Western way of life, but also in striving to improve the quality of that life. Its wider role is one of which many people are completely unaware.



Geography of NATO nations (white) in relationship to the Warsaw Pact (dark tint). Non-aligned countries are in diagonal shading. The arrows, crosshatched for NATO and solid for Warsaw Pact, show the dissimilarities in ease of reinforcement and resupply. The front line is at least 6,000 km from North America, while the Soviet Union has only 650 km to cover when bringing up forces to its western borders. NATO countries are numbered as in the map on the opposite page.

ARWEN gift is lighthearted taunt



United States Army football team supporters indulged in a little psychological warfare when they made a presentation to US Secretary of the Navy, John Lehman.

They were convinced that a riot would break out when the Navy team caught first sight of the muscled Army players before December's big match and felt that it would be equally likely once they had defeated the Navy. John Lehman was therefore going to need a really big stick to put the riot down, and what better than the ARWEN crowd control weapon!

So, to mark the presentation of an ARWEN to Mr Lehman, three days before the game, they had a special plaque suitably inscribed thus: "Presented to Secretary of the Navy John Lehman to help quell the mutiny likely to erupt amongst the Midshipmen from Annapolis when they see the 1984 Army football team eyeball-to-eyeball, and realize you have led them to the Navy's 20th Century Little Big Horn. Imported from Royal Ordnance in Great Britain, which in the real spirit of the Two-Way Street, presents this contribution to Naval gunfire support at a critical juncture in your stewardship. (We'd have given you a 16 inch gun, but thought you'd want something more accurate.) BEAT NAVY!"

And the result of the game? You've guessed it . . . Army did indeed trounce the Navy by 28 to 11. Which was just as well for the Army supporters who, if the result had been reversed, might have had a bigger riot on their hands and would have needed to borrow their gift back!

In this picture John Lehman shows the weapon to Benjamin F. Schemmer, Editor of the American magazine "Armed Forces Journal."

First Aider Margaret leaps into action . . .

If Margaret Brown's First Aid training is never used again she can certainly be proud of her reaction to an incident when her first aid training was called to task.

While leaving a local bingo hall, Margaret, of Whelley, Wigan, who works at Chorley, found herself attending to an elderly lady who had collapsed and was in urgent need of attention.

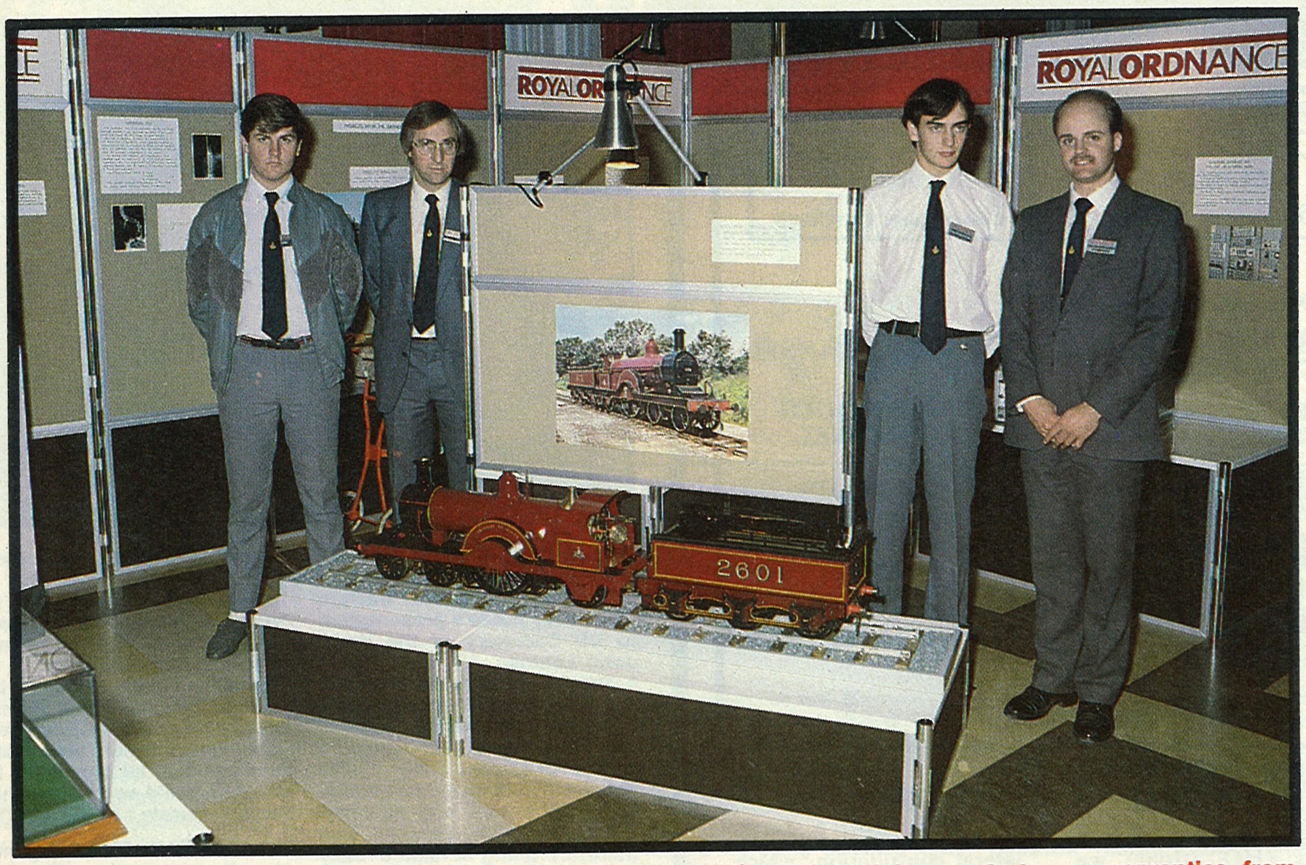
She quickly assessed the situation, placed the patient in the correct posture and remained to comfort and reassure her until the ambulance arrived.

Margaret was able to provide accurate symptoms that helped the ambulancemen diagnose the lady's condition and they gratefully acknowledged her action.

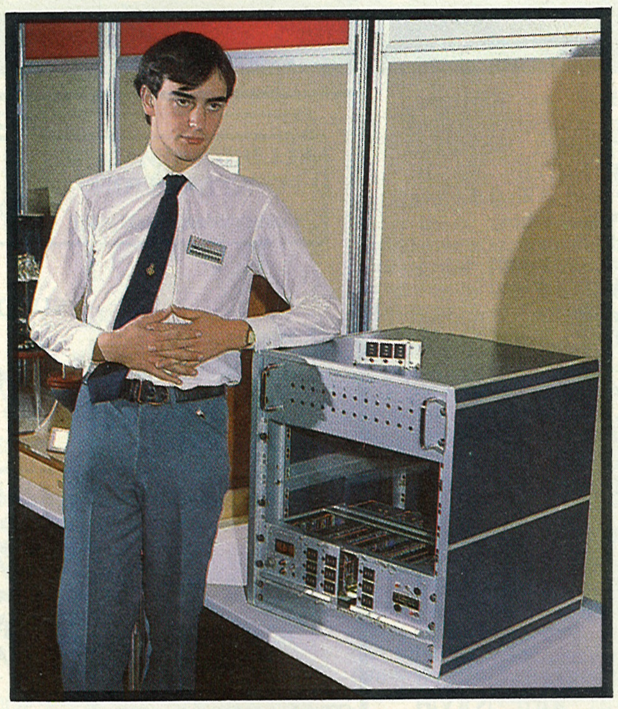
First Aid Tutors at Chorley, led by Dr McNamara, can take comfort that occasions do arise when their enthusiasm bears fruit and their training is acknowledged.

Well done, Margaret!

APPRENTICES' SKILLS GO ON



Overall view of the Royal Ordnance stand with (left to right): Robert Johnson, 2nd year apprentice from Waltham Abbey; Geoffrey Cope of Royal Ordnance headquarters; Jeff Buckingham, 3rd year, Westcott; and Mike Pickering, graduate engineer from Leeds.



Although not involved in building this electronic sequence unit, Jeff Buckingham (3rd year apprentice) poses beside it to represent Westcott where it was made.

One of the most valuable assets in which Royal Ordnance takes a pride is the accumulated skill and expertise of its workforce — a degree of excellence that has long been a tradition.

And once again our apprentices have shown that this high standard will continue to be maintained through another generation. A selection of examples of work completed by apprentices at several of our factories went on view at the MOD HQ in Whitehall last month. The occasion was the annual Ministry of Defence Apprentice Awards Ceremony.

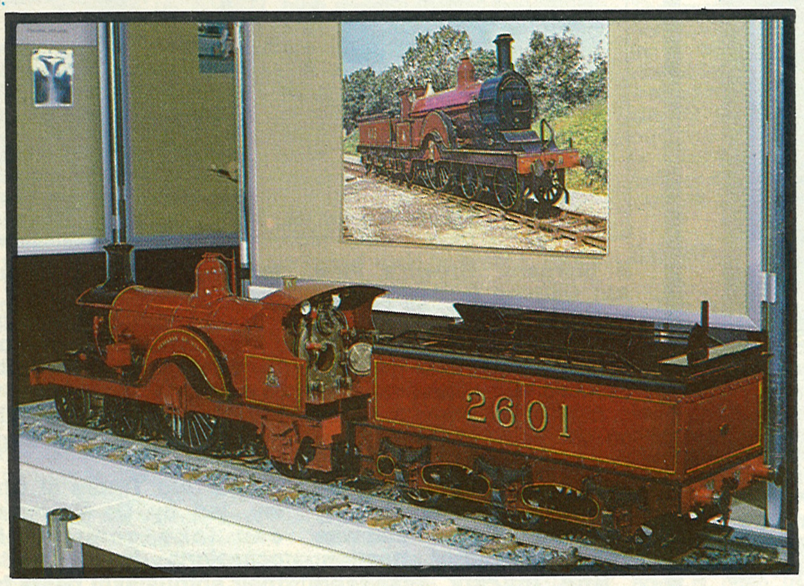
In this issue we take the opportunity to publish photographs of some of the exhibits.

Right: this novel piece of equipment was purpose built by Leeds apprentices for a nine-year-old girl who suffers from a physical handicap which makes her completely immobile and unable to support herself. Now, thanks to the lads' dedication she can get around in this, her very own vehicle.

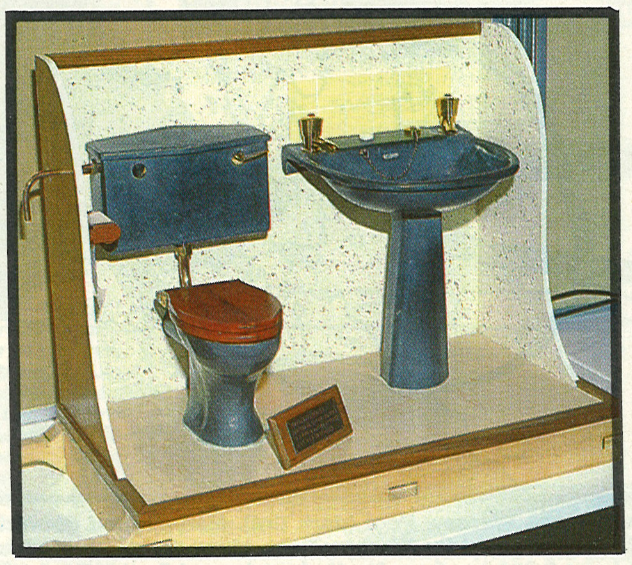
Below: close-up of the Centurion Mk V cutaway model. It was built to mark completion of the refurbishment of a full-size sectional tank by Leeds apprentices from 1982 to 1984. The project was carried out for the Tank Museum at Bovington.

Robert Johnson (2nd year apprentice) with a propellant mixer built by Waltham Abbey apprentices.

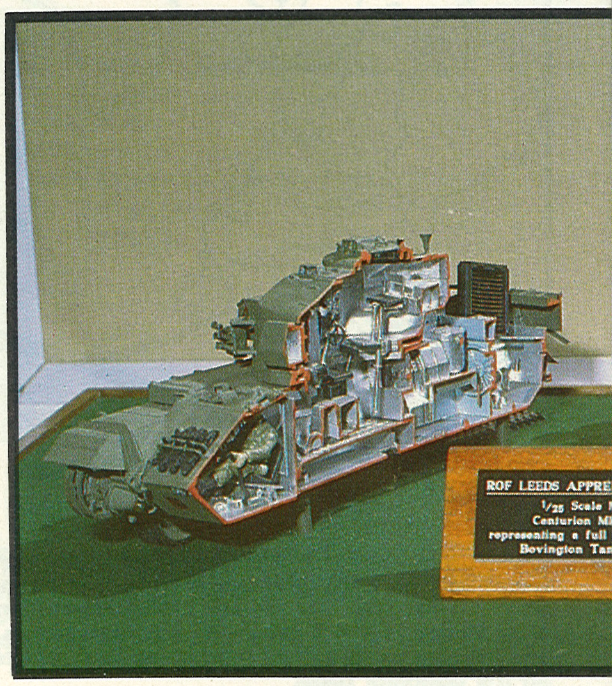
Graduate engineer Mike Pickering represents his factory, Leeds, where apprentices built this superb cutaway model of a Centurion Mk V tank.



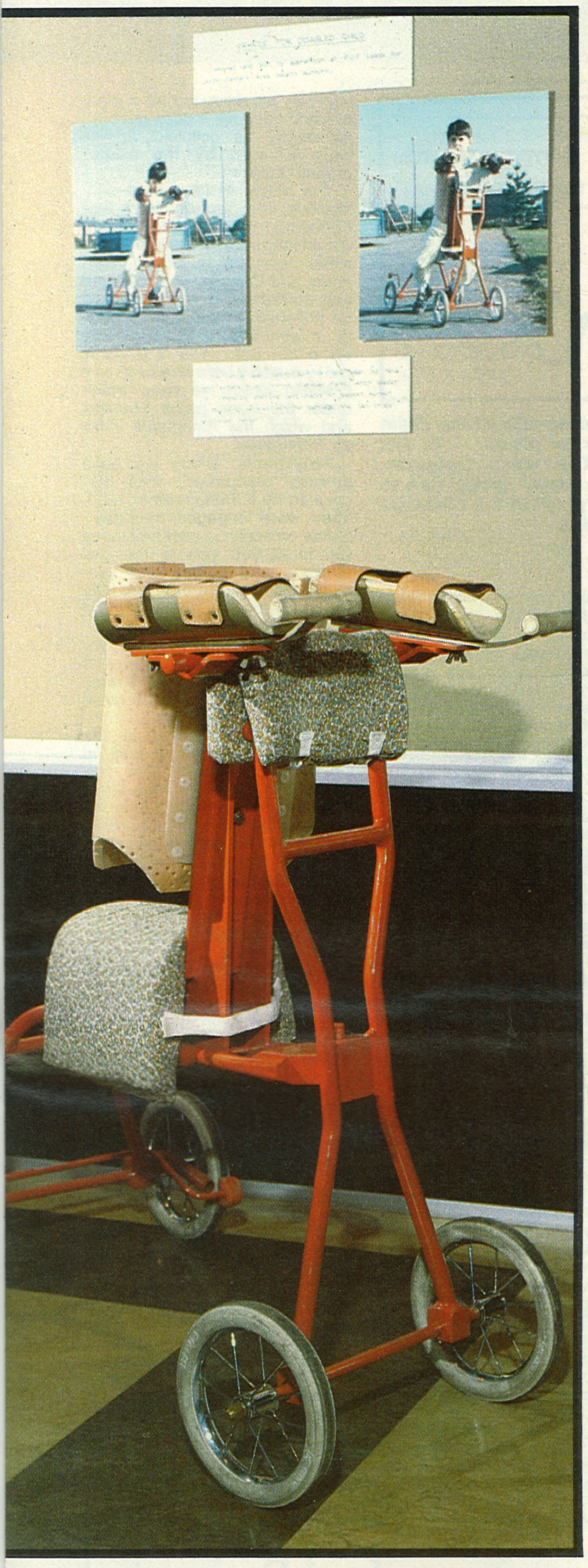
This beautiful working model of the Midland Railway 4-2-2 steam loco "Princess of Wales" was made by Chorley apprentices.

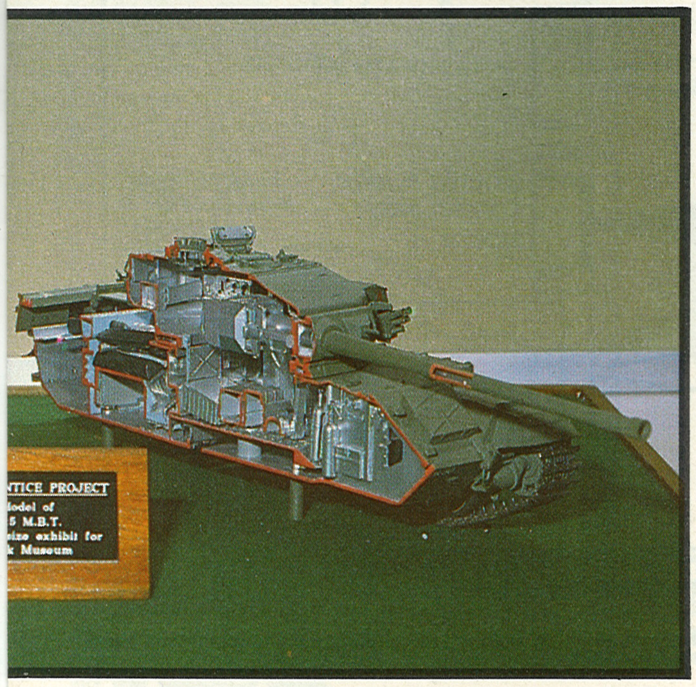


A sheet-metal forming exercise, this large-scale model of a complete bathroom / toilet suite was made by Bridgwater apprentices.



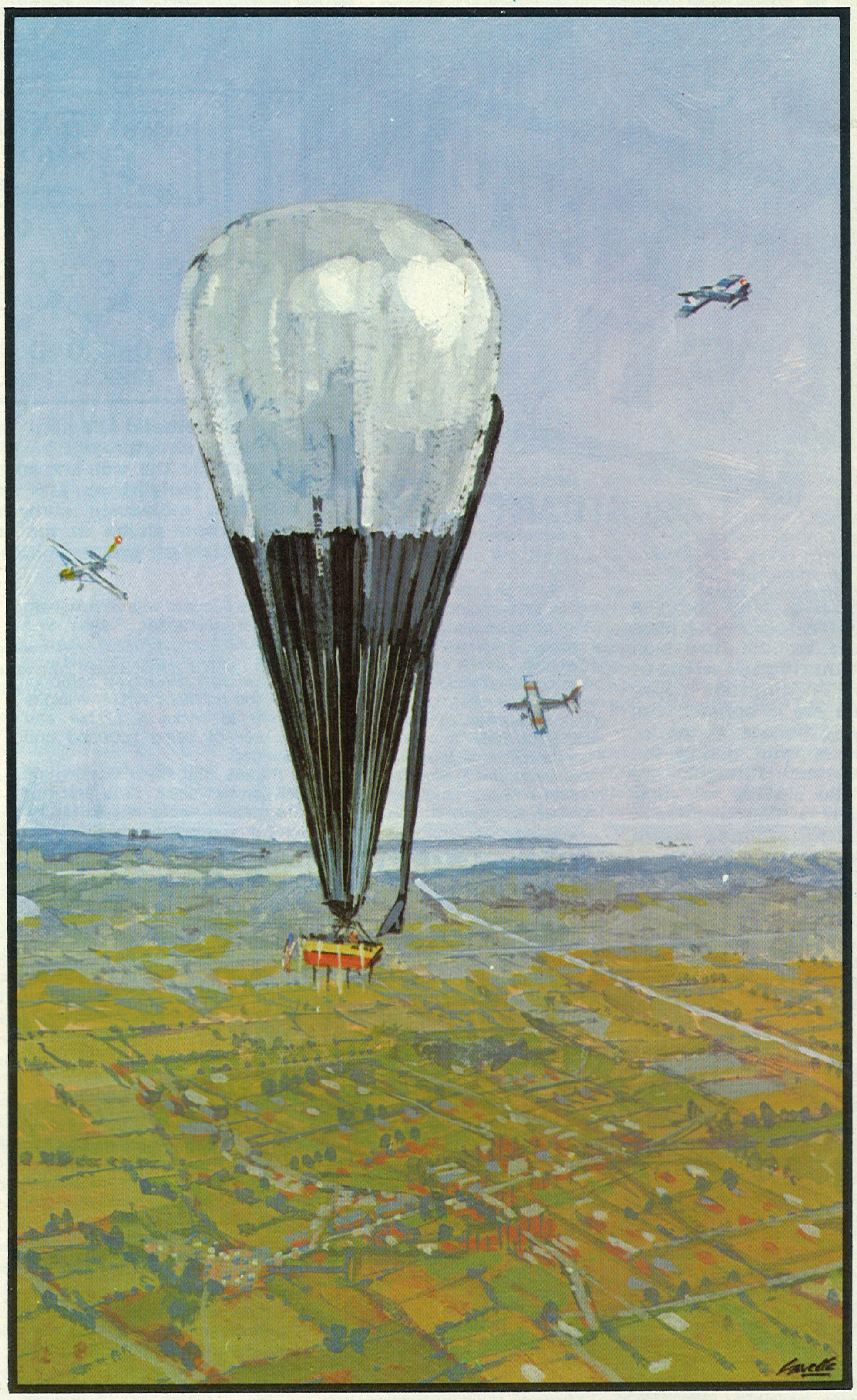
DISPLAY





A moment in history

Don's painting spurs vivid memory of first Atlantic balloon flight



"Double Eagle II" above ROF Bridgwater. The Bristol Channel is in the distance, with Hinkley Point Nuclear Power Station on the shoreline. The River Parrett estuary runs from left to right, and the straight line of the Huntspill River (Keltings Cut, constructed in 1939 to provide water for the then new RDX factory) runs into it. The M5 motorway can just be seen crossing the picture behind the gondola and over the Huntspill River. ROF Bridgwater fills most of the ground below the gondola with the central (Main) road running from bottom left to the middle right of the picture. *(Aerial view impression by artist Don Lavelle of AMQ"G", ROF Bridgwater)*

This evocative painting by **DON LAVELLE,** of Bridgwater factory, captures an historic moment just over six years ago when three intrepid aviators made the first balloon crossing of the Atlantic. Here, Bridgwater's PROFILE correspondent, **LAWRIE HIBBERT** remembers the scene as it passed over the factory . . .

Workers at ROF BRIDGWATER who looked up into the morning sky on August 17 1978 were witnesses of one of man's great achievements. The glint of the morning sun on a silver orb high overhead caught my eye, and I saw "Double Eagle II" — a giant helium balloon encircled by flashing satellites. The tiny silver specks were local aircraft carrying newsmen and photographers anxious to obtain their own personal record of man's first crossing of the Atlantic by balloon.

I had gone to work that morning half hoping to sight "Double Eagle II," never dreaming it would cross my zenith. Nine and a half hours later it touched down in a barley field in the village of Misery outside Paris.

The inspiration for the flight came from an American, Max Anderson, who was an experienced pilot of hot air balloons. His friends, Ben Abruzzo and Larry Newman, a hang-glider pilot, joined him in the venture. On August 11, 1978, "Double Eagle II" lifted off from Preque Isle, Main, near Boston in the USA, to ride a weather "wave" at high altitude and cross the Atlantic in 5 days, 17 hours and 5 minutes. The 52-foot diameter envelope towered as high as an 11-storey building and contained 160,000 cubic feet of helium to lift the 10,500 lb. payload.

Below the boat-shaped gondola was suspended Larry Newman's hang-glider in which he proposed to fly to the ground when the balloon reached its destination. Unfortunately, approaching Ireland, "Double Eagle II" was short of ballast, a common problem in all the best balloon adventures! The hang-glider, liferaft and $30,000 worth of cameras and electronic equipment were thrown overboard to give the balloon lift.

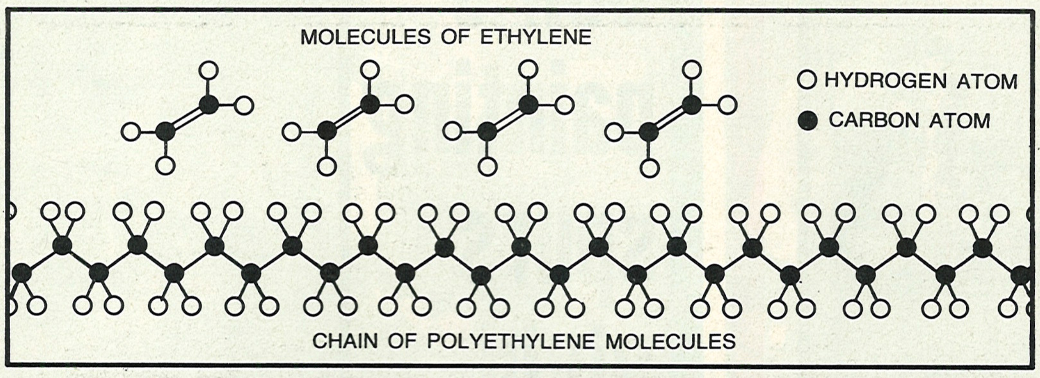
"Double Eagle II" crossed Ireland, Wales and the Bristol Channel, tracking across Somerset, Dorset and the English Channel for her touch-down in France. This first was a wonderful achievement for Max, Ben and Larry and their support team, who had succeeded where 14 previous attempts had failed and five men had given their lives in the adventurous bid to make history.

Plastics—industrial and domestic

TECHNICAL

FACT FILE

by STUART C. FINN



This schematic diagram illustrates the molecular structure of a plastic by using as an example the well-known material polyethylene (polythene). The double-bonded ethylene molecules comprise hydrogen and carbon atoms in the ratio 2:1. The polymerisation process links these molecules with single bonding into a long chain to produce a polymer, or plastic — in this case polyethylene. The word polymer, which means "many parts," gives rise to the use of the prefix "poly" in the chemical names of many plastics.

PLASTICS play such a prominent role in our lives that we wonder how man ever managed without them. Throughout every day we are in contact with many different types of plastic without giving the matter much thought, and even the clothes we wear probably contain plastics in the form of man-made fibres. The products we in Royal Ordnance manufacture involve or incorporate plastic at some stage, whether it be the smallest nylon bush, overall paint finish, or protective packaging.

But in spite of this dependence on plastics, how many of us really know what they are or fully understand their composition? It could be argued that it is not necessary to know, but delving into the subject provides some fascinating answers.

It is commonly believed that plastics are a product of the 20th Century. This is understandable because it was not until the Fifties that use of so many different types of plastic really took off in the consumer products field. And for many years before the war the most widely used and most familiar substance in this field was Bakelite.

Today's availability and widespread use of all these materials is certainly attributable to modern science but the first man-made plastics were discovered or invented in the mid 19th Century. If we want to be pedantic we can go back much farther and note that naturally occurring plastics have been known to man for hundreds — even thousands — of years.

Two categories

Examples are the resins that ooze from pine trees, amber (fossilised resin), horn, ivory, and, of course, bitumen, a large source of which is the 114-acre Pitch Lake in Trinidad, discovered by Sir Walter Raleigh in 1595!

Plastics are, in effect, substances that can be moulded into shape when heated and the man-made types fall into two categories: those produced from natural sources such as the cellulose obtained from trees and plants; and those made entirely from chemicals and therefore called synthetic, such as polythene.

Chief raw materials for production of synthetic plastics are petroleum (from crude oil) and coal. The latter is used less now, but forecasts of the world's oil reserves prompt the thought that coal could well become much more important again in this and other respects.

The distinctive feature of plastics is their molecular structure. While all substances are made up of these small units known as molecules, which, in turn comprise minute particles or atoms of one or more chemical elements, most have short molecules consisting of only a few atoms. Plastics differ in that they have molecules, each of which may contain millions of atoms linked together in a long chain.

A substance containing such long-chain molecules is known as a *polymer* (the word means many parts) hence the names of many plastics which begin with the prefix ***poly.*** Probably the best known is **polythene,** or **polyethylene** to use its correct chemical name.

Polythene is made by polymerising the gas **ethylene** which is made up of double-bonded short molecules structured in the ratio of two hydrogen atoms to every carbon atom. In the polymerisation process the individual molecules (or *monomers)* interact with one another, opening up the double bonds to form a long chain of molecules joined by single bonds. Such a continuous single-bonded chain is more chemically stable and resistant to change than the original double-bonded molecules.

Heat action

Methods of polymerisation vary greatly, but most involve heating the monomer. Sometimes the heating is carried out under pressure, and sometimes in the presence of catalysts.

Polythene is produced by heating ethylene gas under pressure and the resultant material, in its solid condition, can appear in two forms. One is soft and flexible and is known as **low density** (light) **polythene,** while the other is hard and rigid and is called **high density** (heavy) **polythene.** They are produced under different conditions.

Similar to high density polythene and often indistinguishable from it is **polypropylene** which has a higher softening point and features a more shiny surface.

Polythene is one of the *thermoplastics* — substances that, after moulding, can be softened again by heating. This is why a split in a polythene bowl or bucket can be repaired of sorts by running the tip of a heated knife blade along the crack to weld the two edges together. The other type of plastic is the *thermosetting* variety which remains rigid on reheating and therefore cannot be remoulded. An example of this is the material of which electrical plugs are made — **urea formaldehyde.**

The story of man-made plastics began in the mid 19th Century when scientists were seeking a substitute for ivory. First to achieve success was Birmingham chemist Alexander Parkes who produced from *cellulose nitrate* a tough material which looked and felt like ivory. He mixed *camphor* with the normally brittle cellulose nitrate to make it pliable and capable of being softened and moulded.

Parkes had been working on this project since 1855 and had the material ready in time for the Great Exhibition of 1862. He called the substance **Parkesine.** His scientific capabilities were not matched by his busines acumen and his bid to market the material failed.

Two American brothers John and Isiah Hyatt were more successful in their commercial venture when they began marketing John's invention, **celluloid,** in 1869. This material really took off when George Eastman adopted it as a base for flexible photographic film 20 years later.

It was produced from *cellulose,* the woody substance found in plants, and the major source has always been cotton linters. Readers will recognise a parallel here with the production of explosives and propellants.

By acid treatment the raw material is converted into *cellulose nitrate (nitrocellulose)* and plasticised with camphor. The main drawback with celluloid is its high inflammability — small wonder when we consider the other use for nitrocellulose!

Celluloid has been overtaken by the much safer **cellulose acetate,** particularly for film and today celluloid is used chiefly for making ping-pong balls.

The next plastic to be developed was **casein,** in 1897, by German scientists. It was produced from skimmed cow's milk by adding rennet to make it curdle. The solid curd was washed, dried and ground into a fine cream-coloured powder. Water was then added to form a dough which could be moulded. The material then had to be hardened by allowing it to stand in a *formaldehyde* solution *(formalin).* A major drawback was the fact that hardening could take several weeks, or even as much as a year for thick objects. Casein is seldom used now, although buttons and buckles made from it can still be encountered.

Bakelite

The material which brought about a revolution in the manufacture of all manner of products was **Bakelite.** It was invented in 1909 by Belgian born chemist living in New York, Leo Hendrik Baekeland. Four years earlier he had begun experiments to find a substitute for shellac. He produced a powdered resin by a controlled reaction between the coal-tar chemical *phenol* and *formaldehyde.* Phenol (carbolic acid) is often used in disinfectants, while formaldehyde is a gas which, as a solution in water (formalin) is widely used to preserve biological specimens.

The powdered resin that he produced was capable of being moulded into any desired shape by the application of heat and pressure. Named Bakelite after its inventor, this substance is a thermosetting plastic. It is naturally dark and that is why products are either black or dark brown. Its insulating properties were quickly recognised by the electrical industry which adopted it for light fittings, plugs etc.

Bakelite cannot be coloured, but further developments in formaldehyde plastics have given us **urea formaldehyde** (from which the white and cream coloured electrical fittings are made) and **melamine formaldehyde** (plastic tableware etc). These two plastics can be produced in a choice of colours merely by the addition of pigments.

Filler material

In the production of all formaldehyde plastics fillers such as wood "flour" are added to the powdered resin to increase bulk and strength.

It is interesting to note that Baekeland was not the sole discoverer of **phenol-formaldehyde** plastic. In Britain James Swinburne was working along parallel lines and submitted patents for a similar process just one day after Baekeland.

Next major step in plastics research came in 1922 when German chemist Hermann Staudinger published his findings that rubber comprised long-chain molecules which he dubbed *macromolecules.* Thus the theory of *polymers* was set out.

He went on to produce a solid resinous substance from the chemical *styrene.* This, of course, was **polystyrene,** but it was not produced commercially until the late 1930s.

In 1927 German scientists produced the first successful synthetic rubber **(buna rubber).** The quest for a substitute rubber had been pursued for 100 years and in the First World War the Germans came up with a material called **methyl rubber,** but it was of little use.

The buna invention was closely followed by the production by American chemists (led by Wallace H. Carothers) of **neoprene** from *acetylene.* This excellent synthetic rubber made its debut in 1931.

In the First World War the Swiss brothers Camille and Henri Dreyfus set up production centres in Britain and the USA to produce **cellulose acetate** dope for coating the fabric skin of aircraft wings. After the Armistice they turned to production of textile fibres which they had discovered could be spun from dope solution.

By 1929 cellulose acetate was being produced in powdered form as a suitable substance for moulding as a plastic. It is made by treating *cotton linters* with a substance related to *acetic acid.* Many uses are prevalent and it is available in two forms — **acetate** and **triacetate** — both of which can be woven into a fabric. The acetate form in this respect is known as acetate rayon. Triacetate is familiar under the trade name Tricel.

It can be produced as a clear film and because it does not burn as readily as celluloid, it was soon adopted by the photographic industry.

The ability to form solid substances from *acrylic acid* was discovered in 1880 but it did not attract interest until the late 1920s when scientists in Britain, Germany and Canada all discovered that derivatives of the acid could be polymerised into a clear plastic. It went into full-scale production in 1930 as **polymethylmethacrylate (PMMA)** which we know better under the trade name **Perspex** and which the Americans know as **Plexiglass.**

Polythene, which we have already discussed, was discovered by ICI chemists in 1933. They were engaged in experiments on applying high pressures (up to 30,000 psi) to the gas *ethylene* and it was after dismantling their apparatus that they found some of the gas had polymerised.

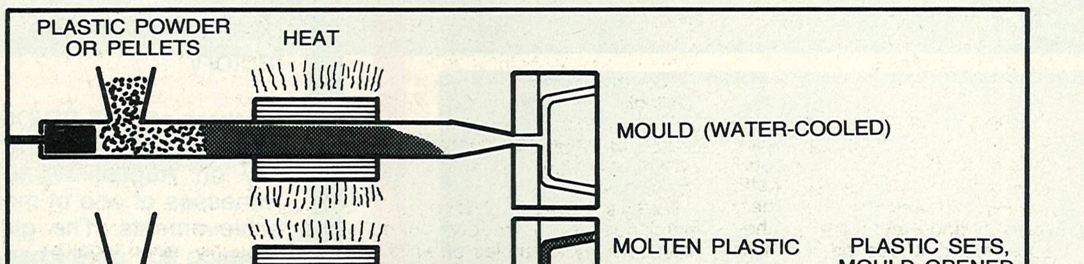
The plastic went into full production in 1939 and as one of its first major applications it was used for insulation in British radar equipment.

Wallace Carothers and his team set out to find an artificial silk of better quality than the cellulose-based rayon then available. In 1935 he found that the molecular structure of silk could be copied by polymerising together *adipic acid* and *hexamethylenediamine* which are both prepared from *benzene,* then obtained from coal tar. The resulting material was called **nylon 6,6** — the figures referring to the fact that the raw materials each contained six carbon atoms in their molecules.

Versatility

When a reaction takes place between an acid and an amine it produces an *amide.* There are several different kinds of nylon but all are amides — or, more precisely, *polyamides,* because they have been polymerised.

Probably the biggest popular effect of nylon when it went into production in the late Thirties was in the production of ladies' stockings and American servicemen are often credited with having introduced them to Britain through their girlfriends during the war! As we know, nylon has extensive uses and the list of products is enormous, ranging from fibres for fabric and rope production to solid items such as mechanical moving parts. Because nylon parts slide over each



Injection moulding of thermoplastics such as polythene and polystyrene. Plastic pellets are fed into the machine, melted by heat and the material is forced through an aperture into a water-cooled mould. When the plastic has set the mould is opened, the product (in this case a washing-up bowl) is removed and the jet or tail of excess plastic from the aperture is trimmed off.

ERSPEX • POLYESTERS • POLYETHYLENE • POLYPROPYLENE • POLYSTYRENE • POLYTETRAFLUOROETHYLENE • POLYURETHANE • POLYVINYL CHLORIDE •

king-pins of 20th Century life

FACT FILE

other so easily they need no oiling and are favoured for gears, bearings etc in many machines, including home appliances.

Plumbers are familiar with **PTFE** tape used to wrap pipe threads before screwing up unions and so achieve leak-proof joints. The letters stand for **polytetrafluoroethylene,** a plastic related to polythene and produced from ethylene. It was discovered almost by accident in 1938 by American scientists of the du Pont corporation who were carrying out research into refrigerants. PTFE is highly immune to chemical attack and has a very slippery surface which makes it ideal for production of non-stick surfaces. This was a use first recognised in the Fifties and now commonplace as a coating for saucepans and frying pans with the material enjoying fame under the trade names of Teflon and Fluon.

PTFE is another example of consumer benefit developed from initial military usage. During the war it was used in equipment in which uranium was purified for production of the early atomic bombs.

Milestones

Wartime saw a number of milestones in plastics development. In 1941 the British scientists J. R. Whinfield and J. T. Dickson produced the textile fibre which became known under the ICI trade name **Terylene.** They made it from the chemicals *terephthalic acid* and *ethylene glycol* and the result of a reaction between an acid and an alcohol is an **ester.** Because it is polymerised the substance they developed is a **polyester.**

Like nylon, a polyester fibre is strong, but it differs in that it resists stretching. Following their discovery it was further found that the substance could be made to link its molecules to form a rigid plastic. This in turn led to the eventual production of **glass-reinforced plastics** used in boat hulls, fishing rods and some car bodies, for instance. Quite simply the material comprises polyester reinforced with fibres of glass and we generally refer to it as **glass fibre.** Fibreglass is not a description but a registered trade name.

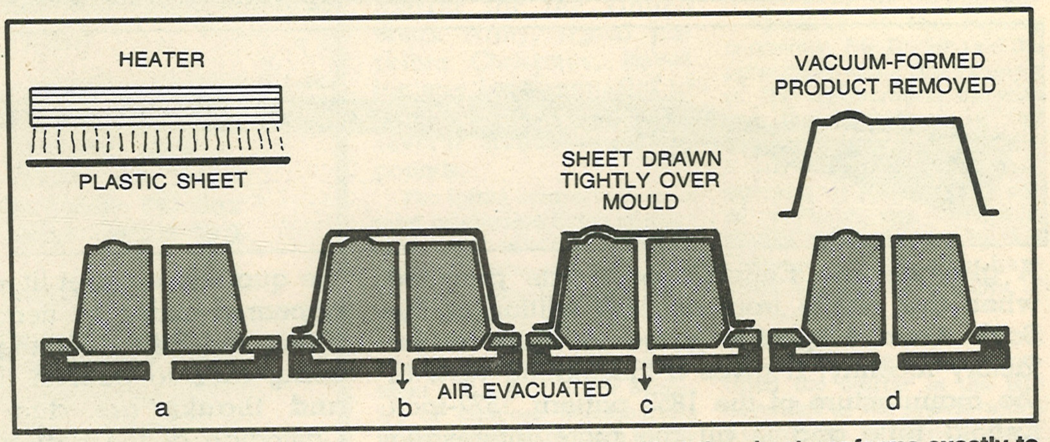
Silicones went into production in 1942, although back in 1900 the British chemist Frederick Kipping had begun studying organic compounds (silicones) which had properties identical to those of plastics but whose molecules comprised chains of *silicon* and *oxygen* atoms instead of *carbon* atoms.

Heat resistant

When, during the war, silicones went into commercial production they were formed in both liquid and solid state as synthetic rubber. Chemically inert, heat resistant and water repellant, they soon found a use as hydraulic fluids in aircraft systems (liquid state) and as silicone rubber as heat resistant seals in engines.

One of our most familiar and widely used plastics is **PVC (polyvinyl chloride)** whose usefulness was first fully recognised in 1943. It has its roots back in 1835 when French chemist Henri Regnault produced *vinyl chloride* from *acetylene* gas which he was studying in depth at the time.

It remained of academic interest until 1913 when German scientists found that it could be converted into a solid suitable for producing textile fibres. So converted it became PVC. By itself, however, it is hard, brittle and difficult to mould, but in 1943 it was found that by the addition of chemicals known as plasticisers it could be made soft and pliable.



Thermoforming is another moulding technique used for thermoplastics. A flat sheet of plastic is softened by heating (a) and then drawn tightly over a mould (b to c). Illustrated in this schematic diagram is the vacuum-forming method in which air is evacuated through small bore-holes which run through the mould (b & c). The vacuum ensures that the sheet conforms exactly to the mould contours. When set the product is lifted off and the process repeated with a fresh sheet. Another thermoforming method dispenses with the vacuum, but is less simple because it requires a downward air pressure or a press employing a former or die.

With rubber at a premium during wartime it was quickly put to use to provide the insulating sheathing in electrical wiring. PVC is versatile in that it can be produced in rigid form, such as that used for guttering, by reducing the amount of plasticiser, or in extremely flexible condition (eg tablecloths and shower curtains) by increasing these additives.

PVC is often confused with polythene and polypropylene and the one true test when trying to identify the plastic is to place it in water. PVC will sink while the other two plastics will float.

The year 1953 saw a major step forward with improvements in the methods of polymerisation, thanks to German chemist Karl Ziegler. He spent much of his life making and investigating organic compounds containing metals. While trying to improve organic aluminium compounds he discovered that they would cause ethylene to form larger molecules. This in turn led him to a low-pressure process for converting ethylene into polyethylene and he found that the result was harder, denser and stronger than the polyethylene produced by high pressure methods.

Plasticisers

Ziegler's work was extended by Italian Giulio Natta to polymerisation of other plastics and both were awarded the 1963 Nobel Prize for chemistry because of their valuable work in this field.

The word plasticiser which has cropped up in this article deserves a word of explanation. Certain familiar plastics are too brittle in their pure form and need to be made more flexible and resilient. This is achieved by the admixture of one or more from a range of chemical compounds which have become known as plasticisers.

Polystyrene (already mentioned) is a widely used plastic, many examples of which can be found in the kitchen, but in its pure form it is crystal-clear and brittle. In this state it is moulded into see-through containers, transparent parts such as cockpit canopies in model kits, etc, but it is liable to crack or shatter when dropped. In its modified state it has been plasticised with synthetic rubber to produce opaque **high-impact polystyrene** which is also coloured to choice by the addition of pigments.

In this form it is familiar as the non-transparent model kit parts, linings of refrigerators, toys, certain kitchen items, bodies of electrical appliances such as transistor radios, coffee makers, food mixers etc. Some such items are made of **acrylobutyl styrene (ABS)** which is more expensive but has higher impact strength and can therefore be produced in thinner shell mouldings.

Another familiar form of polystyrene is the foamed variety. Extremely lightweight, it is the material from which ceiling tiles, protective packaging liners and some heat insulation products are made. In this form it is known as **expanded polystyrene** and is made by heating small polystyrene beads in the presence of a foaming agent. The gas so produced fluffs up the beads which fuse together to produce a single item shaped by the surrounding mould.

Paints and adhesives

We think of plastics as solid objects and it often comes as a surprise to discover that paint can be considered as liquid plastic. Paints are based on resins which, themselves, are plastics (whether natural or synthetic). In its simplest description a paint comprises a coloured pigment in a liquid vehicle plus a solvent to make the vehicle flow more easily. After application to a surface the solvent evaporates leaving the pigmented vehicle to dry into a hard film. The vehicle is the component that contains the resin and plasticisers are added to prevent the eventual paint film from becoming brittle. Fillers are also present to enhance the paint's properties in addition to which they reduce the expense. It is worth noting also that many of today's paints include polyurethane in their production.

Another product which comes under the heading of plastic is the **epoxy resin.** This is a form of thermosetting plastic and it makes a very strong adhesive. A familiar line in DIY and model shops is the fast-acting epoxy adhesive such as those produced by Humbrol and Araldite, featuring a tube of resin and another containing a chemical which hardens the resin once the two have been thoroughly mixed together.

Laminates

The strong plastic sheeting produced for kitchen working surfaces and cupboard unit facings known as laminate is made as a sandwich of several sheets of cheap material such as paper or cloth. These are soaked in a solution of one of the **formaldehyde resins** and pressed together with the application of heat. The cheap material strengthens the sheet and the top layer bears the decorative image. Because this material is a thermosetting plastic it is unaffected by hot pans.

There are several methods by which plastic products are moulded — the choice depending on the type of plastic and the nature or purpose of the finished item.

Injection moulding is suitable only for thermoplastics such as polythene, polystyrene, nylon etc, and it is often possible to identify an item produced this way from the tell-tale mark left when it was cut from the runner (for instance, look at the underside of a polythene washing-up bowl).

Plastic is fed into the injection-moulding machine in powder or granule form, melted in a heating chamber and forced into the mould by a piston. Cold water circulates round the mould's cooling chamber and the plastic sets into the shape dictated by the mould.

Model kits, made from polystyrene, are produced in this way and the moulds are complex, containing several hollows to represent the individual parts. These voids are linked together by small-bore "tunnels" which create the tree or sprue on which the parts are carried.

Straight tubular items such as pipes, and even drinking straws, are produced by the **extrusion** method, which, up to a point, is partly related to injection moulding.

Raw plastic is fed into the machine in granulated powdered form and then heat-melted. Because extrusion is a continuous process (at least in comparison with injection moulding) the machine does not employ a piston to force the material through. Instead it employs a screw or auger, similar to the principle of the kitchen meat mincer. As this long screw revolves it causes the molten plastic to flow forward.

The production end of the machine is not a mould but a die through which the plastic emerges. The diameter of the die dictates the outer size of the tube and its hollow interior is produced by a "bullet" of solid metal fixed dead-centre in the die.

External decorative effects or practical features in the form of longitudinal grooves or ridges can be produced on the plastic tube by corresponding shapes cut into the die. Pipes and tubing can be produced to square, oval, triangular or any other practicable section shape as well as cylindrical.

Incidentally, solid plastic rod can also be produced by extrusion (without the "bullet" blank), although this is usually limited to small gauge by market requirements. An example is the fine rod and filaments sold in model shops.

Blow moulding is also for thermoplastics and is used for production of items such as plastic bottles and many hollow products, particularly toys. It is similar to glass-blowing in that air is blown into a blob of molten plastic inside a cool mould. The plastic expands until it touches the mould and takes its shape, whereupon it is allowed to set.

Slush moulding is another method of producing hollow items like plastic footballs. A mixture of plastic and plasticiser is placed in a hollow mould which is then rotated. The inside of the mould therefore becomes coated with the mixture which then hardens.

Compression moulding is the method used to make products from thermosetting plastics such as Bakelite and the formaldehyde plastics. The moulding powder is placed in the bottom of a heated female mould. As the material melts and begins to set the male mould is brought into place under pressure.

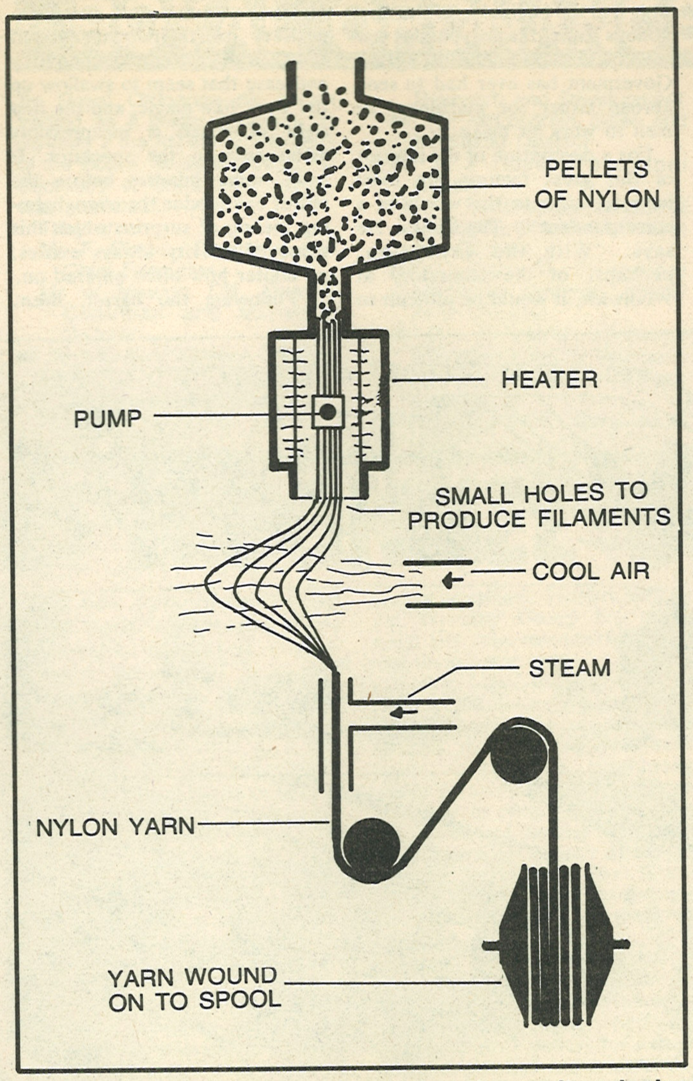
Some plastics can be moulded without heat, and PVC is an example. The method is simple in that the plastic is mixed cold with a plasticiser and placed in the mould. The two react together to form a solid in a similar way to the reaction between resin and hardener of epoxy adhesives. The moulding process is known as **cold casting.**

Thermoforming is another simple method often used to produce egg boxes and thin, shaped liners made from high impact polystyrene such as those used in perfume and after-shave packaging. A sheet of plastic is heated until it softens and then pressed or sucked on to a raised mould.

When sucking is employed in this type of process it is known as **vacuum forming.** The air between mould and plastic sheet is evacuated through small holes which pass through the mould. Certain model kits for specialists are also made in this way.

Plastics have come a long way from the infancy of their general availability in the Fifties when they were regarded as cheap and inferior substitutes for traditional materials. Today they are appreciated for their usefulness and economy. The raw materials may not be cheap but the cost savings are made possible by the ability to mass produce without having to machine every product that comes off the line. The single major expense is a one-off — the cutting and machining of the mould from which a fantastic quantity of identical products can be turned out.

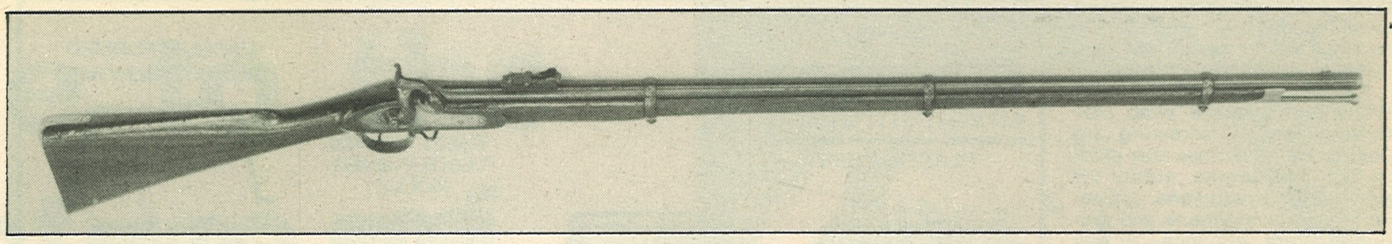
We rely so much on plastics that if world oil resources continue to be depleted, alternative sources will have to be found. The situation may well lead to a massive revival of the coal industry worldwide, or we might have to curtail our use of plastics, limiting them to essentials and products which cannot be made from traditional materials.



Production of synthetic fibres by the melt spinning process — common for nylon and the polyesters. Here nylon, in the form of pellets, is heated to molten state and forced by pumping action through tiny holes to produce fine filaments which are set with the aid of a cold air stream. Application of steam assists the collection of the individual filaments into a single yarn which is wound on to a collecting spool or reel. Acrylic fibres can be produced by melt spinning but in their case the acrylic must be dissolved by a solvent before it can be forced through the holes.

A Victorian discourse

How Boy's Own Magazine told of this weapon's manufacture



A glimpse into Enfield's past was provided when this article from an 1860 edition of the Boy's Own Magazine came to light at the factory recently. It gives a fascinating view of the manufacture of the 1853 pattern, ·577-inch Enfield Rifle and is all the more interesting because it was a contemporary report, rich in the quaintly elegant literary style of the day. It appeared under the heading "Manly Exercises, Rifles and Rifle Shooting." We are fortunate in being able to publish the article here in full, and thanks are due to Bert Woodend, Custodian of the Pattern Room at Enfield, for his kind loan of the illustrations.

WHILE our young riflemen are mastering the principles of the rifle, and occupying themselves with its history, as well as making themselves perfectly acquainted with its several parts, it will be no bad mode of giving diversity to their studies to supply them with a few paragraphs relative to the manufacture of the rifle, and its ammunition. Under the head of ammunition, we shall speak of the bullet, the powder, the cap, the cartridge, etc.

To commence, then, with a brief account of the manufacture of THE ENFIELD RIFLE: The great Government factory for the manufacture of this weapon is at Enfield. "Ordnance Enfield," as it is now called, has sprung up within the last three or four years, and is due to the foresight and experience of Mr. Whitworth, a scientific gentleman whose name is fast becoming famous on account of his improvements in gunnery. Both small-arms and large rifled cannon are being constructed under the direction of Mr. Whitworth, which bid fair to surpass everything of the kind attempted or accomplished either in England, on the Continent, or in the United States.

Mr. Whitworth, when in America, visited the two great centres for the manufacture of small-arms, at Springfield and at Harper's Ferry. Here he saw the various processes by which rifles were turned out in thousands by labour-saving machinery, and reported to our Government strongly in favour both of the Government making its own weapons and the means by which it could best be accomplished. The result of this report was, that the English War Office despatched an agent to the United States, who was empowered, not only to order machines in America, but to engage American engineers to superintend them. This was the beginning of the now famous Enfield factory, and it was the first time the English Goverment has ever had to send abroad either for machinery or men to work or make it.

For a description of the interior of this great factory, we must have recourse to the words of a correspondent to The Times. He says: "With the exception, perhaps, of the laboratory at Woolwich, it would be difficult to name any factory-room in the Kingdom, not even excepting our large cotton-mills, which, at first glance, presents such a bewildering scene of active, never-ceasing industry.

"Let out readers imagine, if they can, a single room more than an acre in extent, lofty, and well lit, in which some thousand men and boys are incessantly employed in superintending machinery. The ear is pained by the hum of fly-wheels, which revolve in thousands till the eye is giddy with their whirl. Miles of shafting are spinning around mistily, with a monotonous hum; the room is almost darkened, and the view completely obscured, by some 50,000 to 60,000 feet of broad, flapping lathe-bands, which are driving no less than 600 distinct machines, all going together, on their own allotted tasks, with a tremulous rapidity and ease that seem to swallow up the work like magic, and the first sight of which is inexpressibly astonishing to the spectator. It takes some minutes before the visitor can subdue the overwhelming feeling of surprise which this scene of activity always excites, no matter how often entered on.

"Following the barrel, then, but with care, into this maze of lathe-bands, we see the process of rifling first commenced. The rifling, in the Enfield barrel, consists of three broad, shallow grooves, with a pitch of half a turn in the length of the barrel of three feet six inches. The depth of the rifling is 0.5 at the muzzle, and 0.13 at the breach, the width of each groove being three-sixteenths of an inch.

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"There are sixteen rifling machines at Enfield, each of which turns out twenty-six barrels a day, though, of course, the grooves are made separately, and after the same fashion as the boring, viz., drawn through the gun, from the muzzle to the breech. Looking at the light through a newly-rifled barrel has an extraordinary effect — the rings of reflected rays showing like bars of black and white metal alternately; and, by the aid of these, as it is said, the workmen are able to distinguish whether or not the tube is perfectly accurate."

The materials for the barrels arrive at Enfield in short square slabs of wrought iron. These slabs are so welded that the fibre of the metal crosses and recrosses at right angles. Each slab measures twelve inches long with a breadth of four inches, the thickness being half an inch. The first thing to do with these slabs is to heat and bond them into a short tube. In this state they resemble a rough, ill-made draining-tile more closely than anything else. They are now again heated to a bright white, and passed between iron rollers, called the "first gauge." This process welds up the joining down the middle, and, by compression, the tube is lengthened to an extent of two and a half or three inches. Another heating follows, and another process of passing the tube between rollers succeeds — this time of a smaller gauge. And so on, again and again, until the tube has passed through thirteen different gauges. When this has been effected, that portion of the manufacture of rifle barrels termed "rolling" is completed. The whole of this process occupies some two hours, and, at the end of this time, the barrel comes out, at length, as a long, slender tube of rough iron, about four feet in length, having a hole down its centre about the size of large pea.

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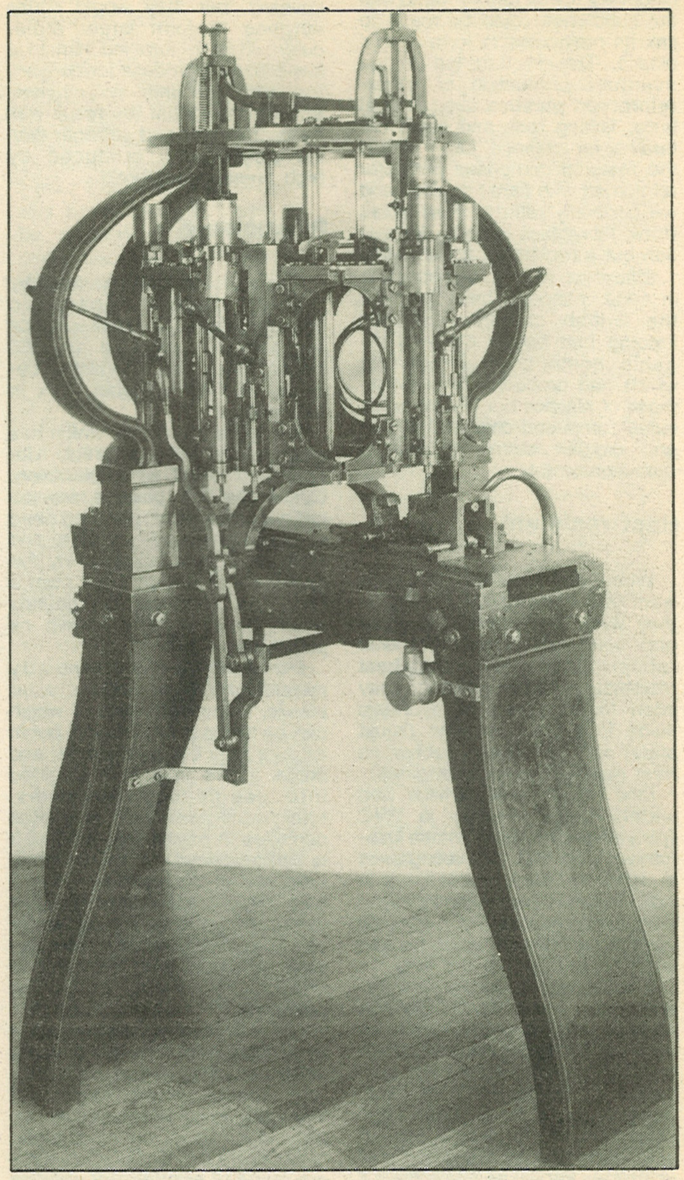
The muzzle of the barrel is now cut off. When the "butts," or ends, have been "made up" the process of welding on the nipple for the cup is begun. This welding-on of the "cone-seat," as it is techincally termed, is a delicate and diffcult operation and no small amount of quickness, care, and skill are required on the part of the workman who effects it. To ensure rapidity of striking while the metals are red hot, the breech of

Contemporary with this article were these splendid engravings showing 11 examples of the manufacturing process at Enfield — truly a valuable historical record.



One of the old machines used in the mid-19th Century, for production of the Enfield Rifle. It was built by the Ames Manufacturing Company of Massachusetts, USA.

on the Enfield Rifle

the barrel, with the nipple for the cap, are placed under a small steam hammer, which strikes at the rate of four hundred blows a minute, and under which, amidst a terrific din, the two pieces of iron are welded together with more then the strength of a single piece.

a terrific din, the two pieces of iron are welded together with more then the strength of a single piece.

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The forgings are now completed; the barrels are consequently passed forward to the boring-shops. This process of boring, which is not to be confounded with "rifling," is repeated on no less than five separate occasions. To accomplish the boring the barrels are deposited in horizontal machines upon which the smallest sized borer is drawn up through them. Formerly the reverse was the practice, the borer being forced down; but this method was found to entail inaccuracy, on account of the bending of the boring-bit as it was forced forward through the tube. A second boring, at "swift-speed," now takes place. A third boring, at "slow speed," succeeds. When this final boring has been made the barrel is completed to within some two or three thousandths of an inch of its proper diameter. The screw-hole for the breech-piece is now bored, and when this has been done the operation of "straightening the barrel," as it is termed is gone through.

The "straightening" is pronounced to be one of the rudest and most unsatisfactory processes of the whole manufacture. The iron used in the construction of the barrel is of an exceedingly fine, soft nature, and this, in conjunction with the extreme thinness of the barrel itself, renders the barrel liable, on the least violence or concussion, either to be bent outright, or else to acquire such a dent in its side as most effectually to put an end to its good shooting. Now, in the processes above described the tube is held to have deviated from its true line in such a degree as to necessitate a considerable amount of rectification.

Strangely enough, this rectification is intrusted, not to unerring and delicate machinery, but to the hand labour of a workman. It is performed in this wise: a workman takes the barrel, and, looking through, proceeds to give it a tap here and a tap there with a hammer, wherever his eye seems to tell him that it requires the blow. When it is remembered that the bore must be true to the thousandth part of an inch, this would appear to be a very rude method indeed. The managers of this factory — clear-headed Americans — however, defend it, and point to the results achieved — two thousand weapons turned out weekly, all of them accurate to half a hair's breadth.

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The milling and grinding stages follow, and all of them relate to the exterior of the barrel. Our space will not allow us to give a detailed account of these processes, amounting to no less than sixty-six. Some idea of the extent of the operations carried on in the Government factory may be formed from the fact that the total number of processes which an Enfield rifle goes through amounts to upwards of seven hundred.

The barrel now undergoes its first proof test. For this purpose the tube is charged with one ounce of powder and a single ball. Under this test not one barrel in a hundred yields; but when the barrel is considered doubtful it is charged with two ounces and a half of powder and seventeen balls — the whole barrel full, in fact — and in this case the tube is ripped up.

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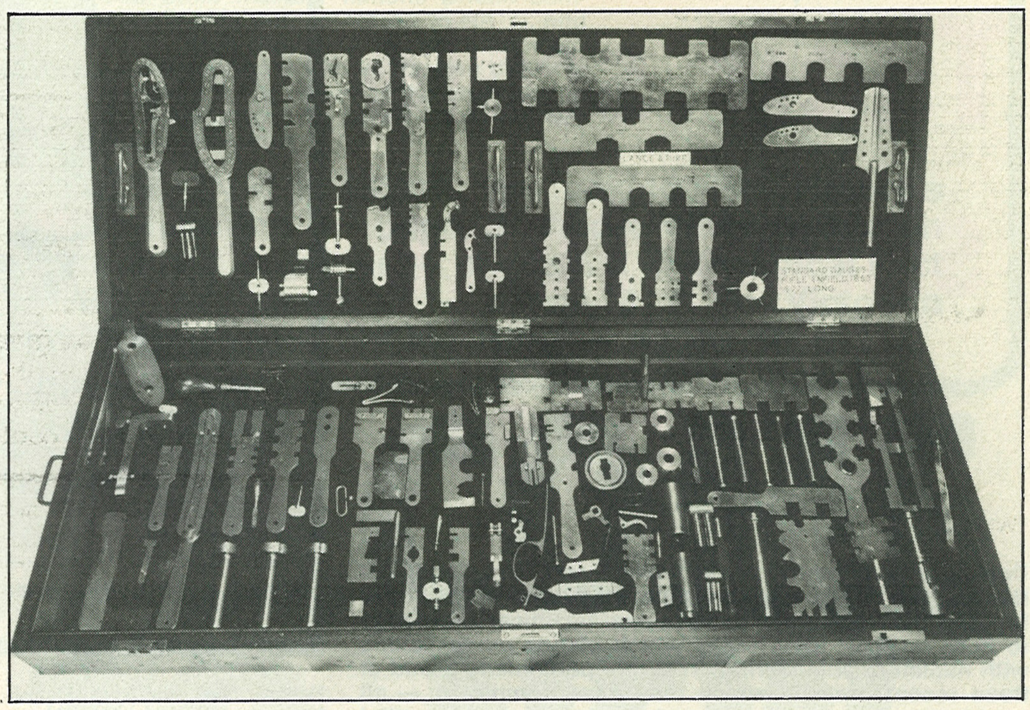
The first proof test made, the nipple-screw, and nipple, and the "tang," or tongue, which fastens the barrel to the stock, are made. It must be mentioned here, however, that not a single piece is put together till the whole rifle is finished to its smallest detail. Before the barrel leaves the boring-room, it has to undergo another boring, the fifth. When this has been done, and when the barrel has been polished by a machine till it shines inside and out, like a silver tube, it leaves for the finishing-shop, there to undergo the fifty-sixth stage of its manufacture.

In our extract from The Times, detailing the operations conducted in the finishing-shop, we have seen how the barrel passes through its rifling stages. When these have been gone through, the barrel is submitted to a second proof-test, in which half an ounce of powder and a single ball are used. This ending satisfactorily, the barrel is retouched, sighted, milled, levelled, browned, and gauged; and, on coming out of the gauge-room after this last operation, it at length presents the appearance of a finished barrel of such perfection of accuracy that a steel gauge of 577 thousandths of an inch — the diameter of the rifle-ball — passes freely through, while another only three thousandths of an inch, sticks firm in the muzzle.



Standard gauges of 1853 for the ·577-inch Enfield Rifle, referred to in this historic article.

The process of browning occupies four weeks, while the whole manufacture of the barrel itself occupies but three. But this browning is not alone an ornamental process. By its aid the gaugers are said to be enabled to detect the slightest perceptible flaw of manufacture, in which case the barrel is instantly rejected, and the workmen under whose hands the imperfection occurred is fined three shillings. Singularly enough, it has been asserted that these imperfect barrels find their way into the market, and are sold, when fitted to stocks, as perfect pieces. This has been denied; but it is certain that these imperfect barrels are sold from the factory, at Enfield, as old iron, and also that a large number of imperfect barrels are to be met with in the second-hand gun trade. A most essential precaution is consequently necessitated. Every purchaser of an Enfield rifle should carefully scrutinize the barrel of the weapon ere he makes it his own by paying for it.

If you go into a gun-maker's shop with the view of purchasing a rifle, and if, on examining the barrel of any weapon offered to you, you see the mark ЯR reject it at once — it would be dear at a gift. This mark shows that the barrel has been rejected by the Government as unfit for use.

● **FOOTNOTE— Reference was made in the article to American engineers, and Enfield's PROFILE correspondent Eddie Collis has discovered from another source that Mr James Henry Burton, who was Master Armourer at Harper's Ferry, USA, was engaged to come to Enfield where he was responsible for the design of many of the new tools and installation of the machinery. Three American artificers from the Springfield Factory were also employed at Enfield as foremen to instruct British workmen in the use of the machinery.**

MODELSCENE

We each have our own preferences when it comes to model subjects and it is strange how inflexible we can be. For instance, if I am building a Leopard tank then I want to finish it in West German Bundeswehr markings rather than those of another user nation. And yet I cannot offer a reasonable explanation why this should be!

Recently I encountered a first class 1/35th scale Heller Humbrol kit of the Leopard A2 with the box lid showing Italian markings. My immediate reaction was to dispense with the decals and painstakingly produce the German markings. That is until closer inspection revealed that the manufacturers have offered a second choice of Norwegian markings.

This alternative grabbed my interest, having seen the Leopards in action up inside the Arctic Circle in northern Norway. It also offers an opportunity to break away from all-drab colour schemes and introduce winter snow camouflage for a change.

The kit is a particularly fine representation of the tank with more than 170 parts featuring undeniably excellent detail. The hull is built from individual pieces and internal bulkheads are provided for strength. Similarly the suspension units comprise many separate components instead of being moulded with the side plates, and this enhances the interest value of the construction of the model.

Identical in its high standard is the Heller Humbrol Leopard A4 in the same scale. Of course, this improved development of the tank has distinctive differences in shape, particularly in the turret which is angular and features flat planes, whereas the A2 has a rounded appearance which has been achieved in a single moulding. The A4 kit provides individual flat plates which means that much more construction work has to be done on the turret.

In both kits I was most impressed with the provision of transparent parts for the lenses of front and rear lights, driver's mirrors and even the turret periscopes.

Interestingly, as a second alternative to the German markings, the A4 kit provides decals for a Leopard in Australian service. In the instruction booklet I was thrown by the heading over the diagram of the German version which gave, for name of country, the initials RFA. Obviously it couldn't mean Royal Fleet Auxiliary — the only full version of this abbreviation that I'm aware of! Eventually it dawned on me — as the kits are made in France I guess the letters stand for something like Republique Federale d'Allemagne.

To sum up, these are two very commendable kits which I recommend wholeheartedly.

Still on the Heller Humbrol theme and this time not an AFV but a military truck — the GMC CCKW 353 in US Army service, with French markings as the alternative. This powerful and mean-looking workhorse is delightfully represented in this 1/35th scale kit which provides a wealth of detail and individual parts. Noteworthy is the amount of work that can be enjoyed in assembling chassis, suspension, engine and drive components.

This is a ten-wheeled job — two at the front and two pairs of double wheels at the rear with final drive to all three sets. I was very impressed with the quality of detail, right down to the canvas cover or tilt which extends from behind the cab to the rear of the vehicle. There is a danger of exceeding true scale when representing canvas texture, but this kit has not fallen into the trap. Texture is just right.

Military vehicles, especially models as fine as these, deserve diorama work and without consuming too much area it is amazing what effects can be achieved in producing a complementary setting for each model.

A good base is imperative and chipboard is ideal for the job. Plywood could tend to warp unless it is of sufficient thickness. Terrain features can be built up using a variety of scrap items and materials normally found in any household, such as Polyfilla. Grass and foliage are no problem as most good model shops stock a range of simulated vegetation, particularly if they cater for model railway enthusiasts.

Camouflage netting really completes the scene and ideal for this is cheesecloth or mutton cloth which can be stretched out to open up the weave. The material should be soaked in a thin solution of white (PVA) glue diluted with water and then draped, folded, etc., to the shape required.

Real netting has pieces of thin rubber sheet cut ragged attached to it in places and from a short distance this simulates foliage effectively. To achieve this sprinkle coarse sawdust or very fine woodshavings (balsa is suitable) over the net while the glue is still tacky. Conversely you may wish to let the soaked net set first and then give another application of diluted glue before sprinkling.

When, complete with foliage effect, the netting is dry, it will need colouring. Dark green is the predominant shade with some dark grey. Although black is present in the real thing this colour is too bold on its own in the scaled down version. Better to use tank grey or mix matt black with dark sea grey. Similarly dark green will need to be toned down by mixing with grey.

Hand painting the net can be laborious but it is the only way for modellers who do not own air brushes. However, the paint should be quiet thin to avoid filling in the open parts of the weave and this has the added benefit of making brushing easier. Naturally, spraying is simplicity itself.

Another source of netting is the type of bag that one buys oranges, etc., in from supermarkets, but take care that the gaps are not too large. This material is of the soft greasy plastic type such as polythene which will not readily accept enamel paint. The net will therefore have to be primed with Humbrol upholstery paint (or thinned white glue as a somewhat less effective alternative).

Turning now to aircraft, Heller Humbrol recently released three rather interesting kits in 1/72nd scale of the Lockheed F-94B Starfire, Lockheed T-33 Thunderbird, and the Etendard IV M. Rather nice representations, they make interesting model subjects for their historical importance.

The Starfire, one of America's early all-weather jet interceptors saw service in Korea, while the T-33 was a two-seat trainer version of the first US jet fighter and it made its maiden flight in March 1948. The Etendard IV went into service with the French Naval Air Force in 1962, having been developed as a light tactical support aircraft for NATO.

All three models are obvious musts for the enthusiast who leans towards to post-war history of aviation.

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And now for something completely different — military equipment of a much earlier age. Humbrol are marketing a range of kits of old cannons and field guns, which use traditional materials with absolutely no plastic.

Made in Spain by Aretesania Latina (well known for their ship models) these are truly beautiful models comprising wood, brass, bronze and steel components. The barrels are beautifully turned in brass and bored out to a suitable depth for visual appearance. Even round shot is provided in the form of steel ball bearings.

The wooden parts have been rough cut and require sanding with very fine grades of glasspaper and flour paper before assembly and glueing. The manufacturers have not used any old wood. Indeed, they have made use of timbers such as walnut, boxwood, and bokapi. In addition to the many finely produced components, each kit is complete with a wooden mounting base.

The range includes a 24-pounder of the Louis XIV period, a French field gun of 1490, a Krupp 75-mm field gun designed in 1909 particularly for deployment in mountainous terrain, a British nine-pounder on its own and one with limber (this gun was in use throughout the Napoleonic Wars through to and including the Crimean War), and a beautiful British Naval 12lb cannon complete with a section of deck and hull with gun port and hatch. With the exception of the naval gun, which is 1/16th scale, the others mentioned are in 1/32nd.

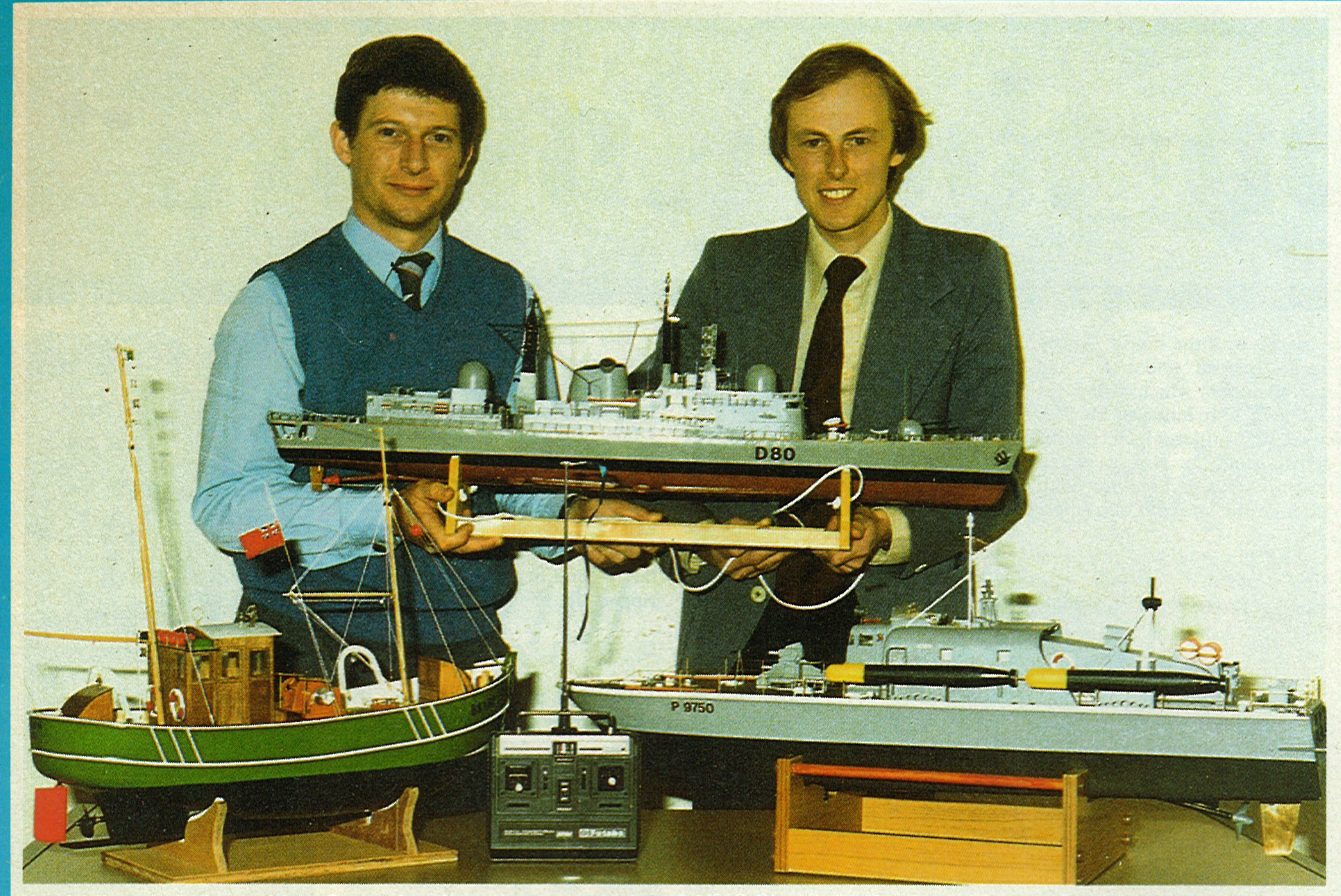
They produce wonderful finished models and are a joy to build. The wood can be brought up to a beautiful finish either with varnish or by wax polishing. The brass is in danger of tarnishing and the makers suggest the use of varnish. In the case of the British Naval gun it would be more realistic to give the authentic black finish even though it is a shame to cover the brass.

Each kit deserves closer consideration than can be given in this edition of Modelscene so we shall return to the theme in a later issue.

STUART C. FINN

ENGINEERING IN MINIATURE

Their scale ships take to water



David Walsh (left) and Ian Sager holding the fine model of *HMS Sheffield*. On the table are the fishing vessel *Helen* and the *Perkasa* class fast patrol boat.

Design draughtsmen David Walsh and Ian Sager, of Blackburn's Design and Development Drawing Office have brought their combined professional technical knowledge to bear on their joint hobby which blends modelmaking with miniature engineering. They are particularly proud of three recent projects which they have completed — all working models of ships — and which include a beautiful scale representation of *HMS Sheffield* which was lost in the Falklands conflict. Prompted by PROFILE's regular Modelscene feature, they felt that other readers might like to know about their work and so have put pen to paper. The account begins with David's comments on his fast patrol boat . . .

I HAD wanted to build a high speed model boat for the past ten years but had never been able to find the time. However, in 1983 I finally decided to make the effort and get cracking.

My choice was the *Perkasa* class of fast patrol boat, the kit being manufactured by Presedent Kits. It seemed just the right size with just enough detail. Unfortunately I didn't have any previous modelling experience and the instructions and quality of materials of the kit were found to leave much to be desired. Naturally I made mistakes but in the end patience and good planning paid off.

I finished the model just before last summer. It had taken many hundreds of hours to build over a period of eight months. It has been really hard work and sometimes heavy going but I am personally very pleased with the final result. Only by close inspection of the craft can one appreciate the fine detail and the effort that has gone into producing it.

The model is scaled 1/32 the size of the real thing and is 37 inches long. It is powered by ten 1.2 volt/4 amp hour rechargeable dry batteries which drive a large 6 volt electric motor (6,000 rpm) coupled to a single propeller shaft with a two bladed speed prop.

The history of this class of boat is equally interesting: In 1968 18 Vosper gas turbine powered fast patrol boats were in service for the Royal Navy, the Royal Hellenic Navy, the Royal Danish Navy, the Royal Malaysian Navy, the Brunei Navy and the Libyan Navy. They were all made by Vosper Thornycraft and powered by three Rolls-Royce Proteus gas turbine engines each rate at 3,620 bhp max and 2,960 bhp continuous on three separate shafts giving maximum speeds between 50 and 60 knots, range 400 miles. Combined with two 230 hp General Motor diesels on winged shafts for cruising and manoeuvring giving a range of 2,000 miles.

Armament generally consisted of two 40 mm Bofors guns or one 40 mm and one 20 mm cannon with four 21 inch diameter torpedoes, but now that lightweight anti-ship and anti-aircraft guided missiles are available the remaining craft and fitted with, eight Aerospatiale SS-12M close range surface to surface wire guided missiles, range 6,000 metres, impact speed 182 knots.

Four "Perkasa" class craft were built for the Royal Malaysian Navy and were delivered in 1967.

The main hull and deck structures are made out of glued, laminated wood, whereas the superstructure is made out of aluminium alloy.

The crew consists of two officers, three petty officers and 16 ratings.

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HMS Sheffield

This model was scratch built, with a planked wooden hull and a superstructure mainly of plastic sheet and strip and rod, and is 39 inches long.

As the model was wanted for radio control it was necessary to add a motor, for which a 6 volt Monoperm was chosen with power provided by Nickel Cadmium rechargeable batteries. Also incorporated are the required servos for speed control and steering.

The drawings were obtained from Jecobin Ltd of Woking, Surrey, and were extremely detailed. They consisted of a main drawing of plan, side elevation and several sections, and a view showing the bulkhead shapes. Several separate detail sheets were used, of larger scale, for the more intricate parts of the ship such as radar antennae, gun, missile launcher etc.

The model was constructed at weekends and in the evenings and took approximately nine months to complete.

The ship on which the model is based is the Type 42 Guided Missile Destroyer, which unfortunately now lies at the bottom of the South Atlantic.

The *Sheffield* was born out of the far-reaching consequences of the 1966 decision to phase out the aircraft carrier from the Royal Navy; she was in fact the smallest possible Sea Dart Platform that could be built, and was somewhat inferior to ships of the US Navy rated as frigates and hardly merited the designation of destroyer.

She was laid down at Vickers Shipbuilders on January 15 1970 and launched on June 10 1971. After completing her final sea trials at the beginning of 1975, she was moved South to Portsmouth for formal commissioning on February 28 1975, by then she had cost £23 million.

She was of 4100 tonnes and her dimensions were 412 feet overall length, with a 47-foot beam and 22 foot draught. She was powered through two shafts to two five-bladed variable pitch propellors, by two Olympus and two Tyne Gas Turbines giving 56,000 SHP (29 kilowatts) main drive and 8,500 SHP (18 kilowatts) cruising.

Her main armaments were one twin Sea Dart GWS 30 Missile System with 22 rounds, and one 4.5 inch Mk 8 Automatic Gun. She also carried a Lynx Helicopter armed with Mk 46 torpedoes or Sea Skua missiles. She had an endurance of 4,000 nautical miles, and a complement of 26 officers and 273 ratings.

On her last day, Tuesday May 4 1982, she was acting as a screen to the two carriers, *HMS Hermes* and *HMS Invincible*, around the Falkland Islands and was stationed some 20 miles ahead of *Hermes*. The ship was at defence stations, the second state of readiness, and the cooks were about to serve a meal from the galley when danger approached.

She was, at that particular time, transmitting a message back to fleet HQ at Northwood via the satellite link, and to prevent interference, her main surveillance radar, was switched off; but to compensate for the gap, a repeat picture of radar being received in *Hermes* was being transmitted via data link.

At that point three aircraft were detected on *Hermes*' radar, they were super Etendards of the Argentine Naval Air Arm, carrying AM 39 anti-ship missiles, one aircraft released an Exocet at a range of 25-30 miles.

On board *Sheffield* there were four or five seconds' warning before the missile struck. It hit on the starboard side amidships at No 2 deck level, 30 degrees from centre; it travelled into the forward engine room, aft over the gas turbines and ended up in the after bulkhead without detonating, (as subsequent photographs proved). Within a very short period of time the ship was filled with smoke from cable runs and later fuel lines burning.

The ship was later abandoned and the fit and injured were transferred to other ships in the fleet. The hull was left to burn itself out but did not sink, a few days later she was taken in tow, but as the weather worsened she began to take on water through the gaping hole in her side. She sank on May 10 laid to rest with her dead crewmen as a marked wargrave.

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Our third model — that of *Helen* — was bought in kit form. It is 25 inches in length, and was complete apart from motor, batteries and radio control equipment.

Fairly straightforward to build, it was well supported with a good, clear instruction manual and detailed assembly drawing.

The hull and several of the larger parts were pre-formed ABS but the wheelhouse, companionways, masts and spars were of wood; the construction time was approximately five months, and when launched recently the model manoeuvred very well indeed.

It is a model of one of the small fishing or shrimping cutters operating in the North and Baltic Seas, and their characteristic appearance has made them one of the most popular subjects for modelling for years. One reason for this is the fact that a large scale can be chosen at which many details can be fitted in comfortably.

Since becoming modellers we have joined a local model boat club, Bury Metro Marine Modelling Society.

The club holds meetings on the first Wednesday of each calendar month and sails every Sunday morning, between 10.30 am and 1 pm on a large open air swimming pool behind Bury General Hospital.

Boats are restricted to electric power and sail — internal combustion engines are banned because of the position of the pool close to the hospital.

We have been full members since January 1984 but have been attending club meetings and activities since August 1983. Everyone has made us very welcome indeed.

If any readers in this area are interested in joining or require further information about the club they should write to: The Secretary, Bury Metro Marine Modelling Society, C/O Mr Ken Taylor, 14 Otterbury Close, Bury, BL8 2TY; Tel: 061-761-6008.

IN ACTION . . . 81mm mortar


Infantry in NBC (nuclear, biological and chemical) protective clothing go into action with the version of the 81mm mortar that is to equip United States forces. A £2.1 million order from the US Army was formally signed in London in December. Full story page 3 and pictures page 1.

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