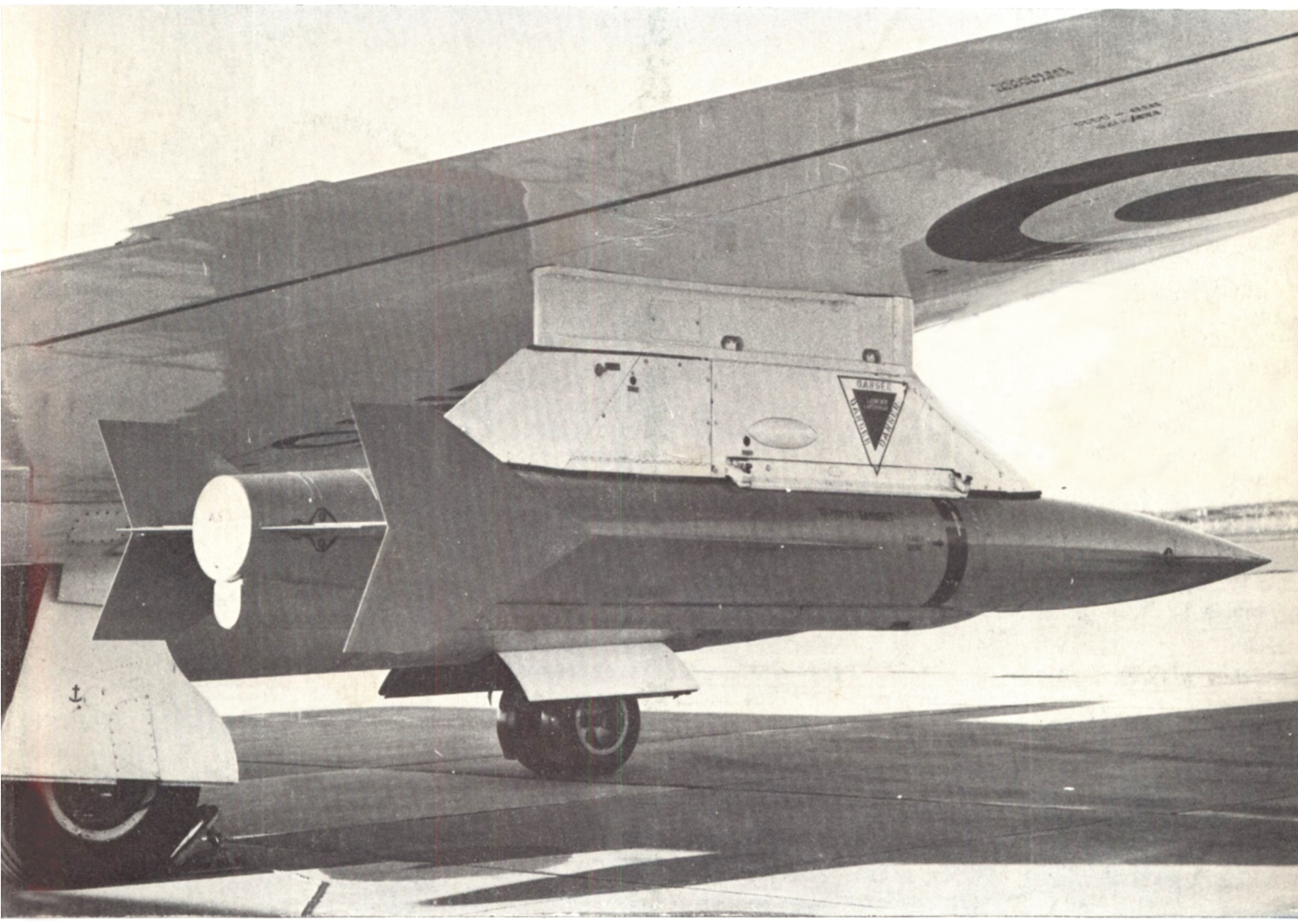




AUGUST 1974

THE
aeronautical
JOURNAL



THE ROYAL AERONAUTICAL SOCIETY

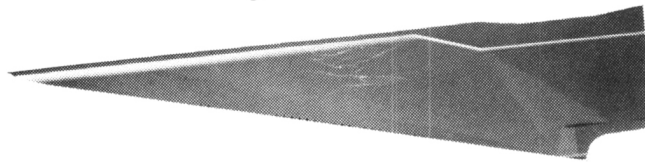
Without our new 5,000 tonne press some great ideas would be castles in the air.

We've been making compressor,
turbine and fan blades for the
aeronautical industry for over thirty
years. It's a fast moving business.



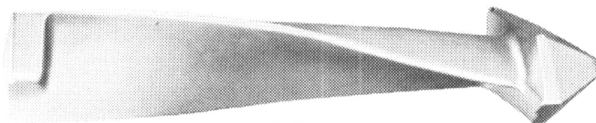
Titanium alloy.
Maximum projected area: 580cm² (90"²).

So we've had to move with it to
maintain our position as one of the
largest producers of close-to-form
forged blades in Europe.



Aluminium alloy, Hiduminium 58.
Maximum projected area: 1600cm² (250"²).

Our new 5,000 tonne press looks
forward too. With it's help some of the
bright ideas of the near future will get
off the ground.



Nickel alloy.
Maximum projected area: 450cm² (70"²).

And the chances are that most of the
aeroplanes you're seeing today rely on
HDA expertise to get airborne.



HAWKER SIDDELEY
HIGH DUTY
ALLOYS LTD.

89 BUCKINGHAM AVENUE, SLOUGH, BUCKINGHAMSHIRE.

Hawker Siddeley Group supplies mechanical,
electrical and aerospace equipment with
world-wide sales and service.

VOLUME 78
NUMBER 764
AUGUST 1974

THE **aeronautical** JOURNAL

*Incorporating The Institution of Aeronautical Engineers and
The Helicopter Association of Great Britain*

Published Monthly

contents

*Editor: G. R. Wrixon, ARAeS,
TEng(CEI).
Assistant Editors:
Jay Wolff, David Scallan.*

*Secretary of the Society:
E. M. J. Schaffter, MA, CEng,
AFRAeS
4 Hamilton Place, London,
W1V 0BQ. Tel: 01-499 3515.
Telegrams: Didaskalos, London, W1*

*Reproduction of any of the papers
published in this journal is not
permitted without the written
consent of the Editor.*

*None of the papers or paragraphs
must be taken as expressing the
opinion of the Council unless
otherwise stated.*

*Advertisements:
John G. Newman,
The Royal Aeronautical Society,
4 Hamilton Place,
London W1V 0BQ.*

*Printed by
Lewes Press Ltd.,
Lewes, Sussex, England.*

*Subscriptions: £20 per annum,
post free.*

*Single copies, including back
numbers: £1.75.*

*Published by
The Royal Aeronautical Society,
4 Hamilton Place,
London W1V 0BQ, England.*

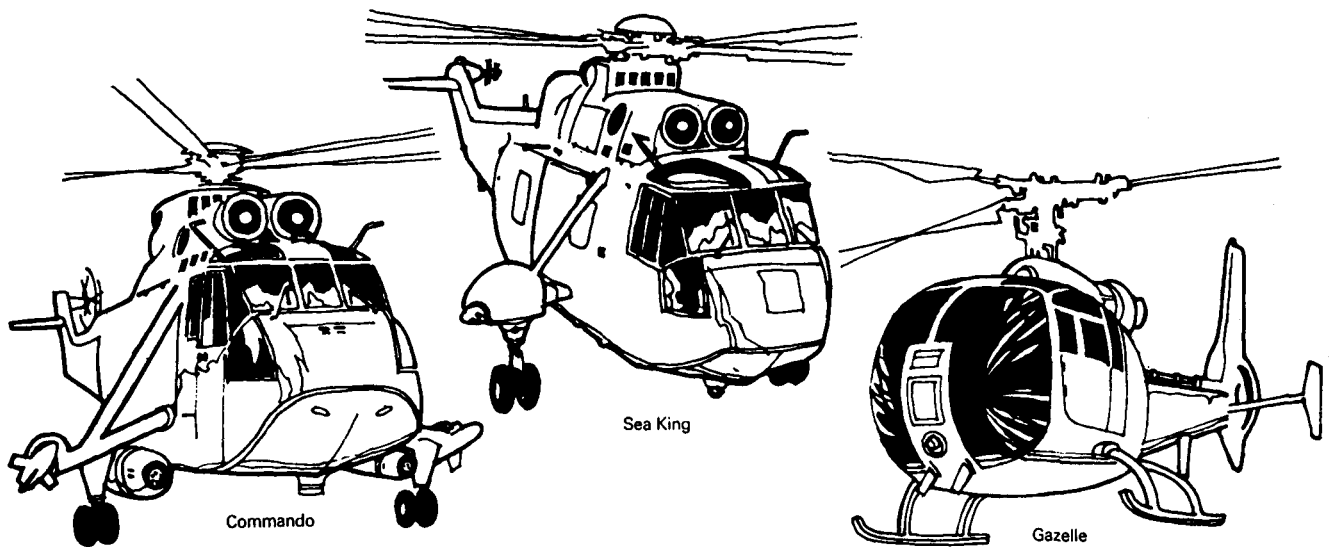
Cover picture:

Remotely piloted vehicles (RVPs) are now coming into greater prominence with the escalating price of conventional piloted military aircraft and the increasing effectiveness of the opposing defensive systems. Col. Hemenway in his paper in this issue relates the history of the drone up to the present date, as far as security would allow. The cover shows the Beech Stiletto (US Navy designation AQM-37A) supersonic target drone mounted on a Canberra launcher for use on UK weapon ranges. The modifications to the drone and aircraft were by Shorts of Belfast, who have also extended the flight profile of the Stiletto.

Egon Krause APPLICATION OF NUMERICAL TECHNIQUES IN FLUID MECHANICS	337
Ward W. Hemenway DRONE/RPV SYSTEMS	355
I. C. Cheeseman HELICOPTERS—PEOPLE AND PLACES	363
TECHNICAL NOTES	
J. A. Sova and T. R. G. Williams Fatigue properties of the Alclad Al-Cu-Mg-Si-Mn alloy	375
B. Probert A method of obtaining sub-critical compressible velocities for two-dimensional aerofoils from an exact inviscid incompressible solution	380
P. Arnot Smith The plane jet growth rate as influenced by a wall in the plane of the nozzle	384
Library, Reviews, Additions, Reports	386

Westland

the worldwide choice in helicopters



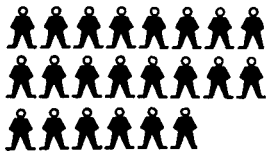
Anti-submarine Warfare



For all-weather operation from small ships, naval **Lynx** is the most advanced complete anti-submarine weapon system, designed to meet operational needs of the world's navies.

Sea King is a self-contained tactical unit able to

detect, classify and destroy high-speed submarines in all weather conditions from ship or shore; in world-wide service with Royal Navy and ordered by Norway, Germany, India, Australia and Pakistan.



Search and Rescue

Unequaled in its SAR role, **Sea King** can rescue up to 22 survivors. With its advanced avionics, over 500 km radius of action, and ability to operate by

day or night from ship or shore in all weather conditions, **Sea King** is today's most effective search and rescue helicopter.



Tactical Transport

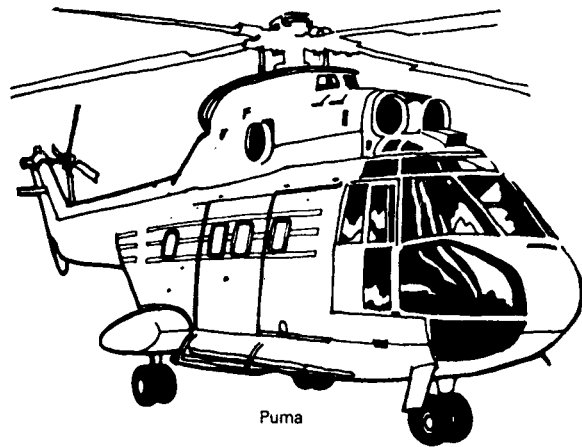
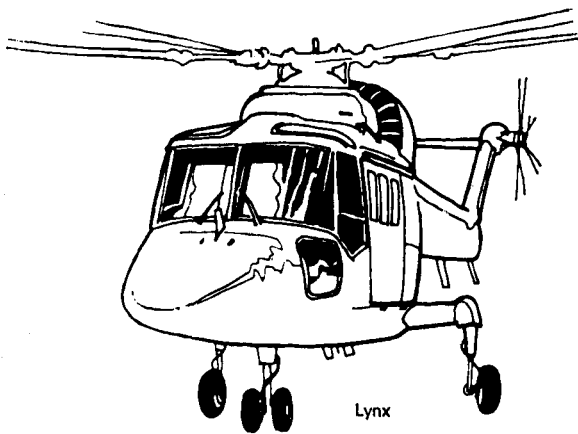
Up to 34 battle-ready troops or 3,820 kg freight can be carried in **Commando**. With all the power reliability, outstanding performance and unrivalled economics of **Sea King**, from which it has been specially developed for land use, **Commando** is now in full production.

10 fully-armed troops or 1,508 kg freight can be moved anywhere at 275 km/h plus in military **Lynx**. Fighting troops have tactical superiority with this completely new aircraft, first of the next generation of helicopters.

Lightest helicopter in the Westland range, **Gazelle** carries 4 passengers or 600 kg freight; 3 world class records and over 4 million engine flying hours back its claim to high performance and complete reliability; speed and manoeuvrability make it particularly suitable for surveillance and fire direction.

Puma, first product of Westland Aerospaziale cooperation and now in world-wide armed forces service, can carry 16 fully-armed troops or 1,600 kg freight.

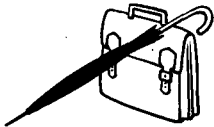
Outstanding in performance,
reliability and equipment
the Westland range offers the
world's best helicopters to meet
every major role



Anti-tank Operations

Military **Lynx** is the world's most advanced helicopter for anti-tank operations. Fast (2 world class speed records), agile (semi-rigid rotor) and compact, **Lynx** offers exceptional controllability and tactical superiority.

Commando, Puma, Lynx, Gazelle can be fitted with a wide range of external and internal armaments to make each of them the most formidable fighting machine in its class.

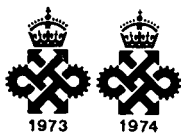


Civil Transport

Fast and elegant, and with service support centres throughout the UK, **Gazelle** gives 5-seat comfort and reliability to the country's business leaders. And the

Westland 606 – fastest and safest helicopter in its class, with twin turbines, day or night all-weather capability and 7 to 12 seats – is about to go into production.

*A member of the
Westland Group
of Companies—
6 times winner of
the Queen's Award
to Industry*



Westland
WESTLAND HELICOPTERS YEovil ENGLAND

*Talk to
Westland about
Helicopters
on Stand N58*

The Royal Aeronautical Society

FOUNDED 1866

INCORPORATED BY ROYAL CHARTER 1949

Patron: HER MAJESTY THE QUEEN

COUNCIL

President: B. P. LAIGHT, OBE, MSc, CEng, MIMechE, FRAeS

President-Elect: AIF, MARSHAL SIR CHARLES PRINGLE, KBE, MA, CEng, FRAeS

Vice-Presidents:

C. ABELL, OBE, FSLAET, CEng, FRAeS
G. R. JEFFERSON, CBE, HonBSc, CEng, FRAeS
H. DAVIES, CB, MSc, CEng, FRAeS

Past Presidents:

S. D. DAVIES, CBE, BSc(Eng), CEng, FRAeS
K. G. WILKINSON, HonDSc, BSc, DIC, FCGI, CEng, FCIT, FRAeS
DR. G. S. HISLOP, PhD, BSc, ARCST, CEng, FRAeS

Members:

AIR CDRE F. R. BANKS, CB, OBE, HonCGIA, CEng, HonFAIAA, HonFRAeS,
RAF (Ret'd)
CAPTAIN E. C. BEARD, CBE, CEng, FIMechE, FRAeS, RN (Ret'd)
M. J. BRENNAN, BSc, CEng, FIMechE, FRAeS
F. R. J. BRITTEN, CBE, CEng, AFRAeS
D. G. BROWN, BSc, DIC, CEng, FRAeS
CAPTAIN E. M. BROWN, CBE, DSO, AFC, FRAeS, RN (Ret'd) (*Chairman, Rotorcraft
Section*)
PROF. L. F. CRABTREE, BSc, DIC, PhD, CEng, AFAIAA, FRAeS
M. G. FARLEY, CEng, FIMechE, MBIM, FRAeS
D. J. FARRAR, OBE, MA, CEng, FRAeS
WG. CDR. N. F. HARRISON, AFRAeS, (*President, Southern Africa Division*)
M. R. HAYES, MSc, BSc(Eng), ACGI, (*Chairman, Graduates' and Students' Section*)
AIR VICE-MARSHAL F. S. HAZLEWOOD, CB, CBE, AFC, FRAeS
DR. W. F. HILTON, PhD, DSc, CEng, AFAIAA, FRAeS
W. ISBISTER, BSc, BE, CEng, FRAeS (*President, Australian Division*)
AIR CDRE J. R. MORGAN, OBE, BSc(Eng), CEng, FIMechE, FRAeS, RAF (Ret'd)
G. M. MOSS, MSc, CEng, AFRAeS
DR. E. S. MOULT, CBE, BSc, CEng, FIMechE, FRAeS
AIR CDRE F. C. PADFIELD, BSc, CEng, AFRAeS, (*Chairman, Astronautics and
Guided Flight Section*)
G. K. C. PARDOE, BSc(Eng), DLC, CEng, FBIS, FRAeS
T. R. PIKE, AFRAeS (*President, New Zealand Division*)
R. P. PROBERT, Esq, CB, MA, CEng, FRAeS
H. RADNITZ, CEng, AFRAeS, (*President, Rhodesia Division*)
J. T. STAMPER, MA, CEng, FRAeS
DR. A. M. THOMPSON, PhD, BSc(Eng), GradRAeS
G. T. WANSBROUGH-WHITE, ARAeS
H. ZEFFERT, CEng, FIEE, FRAeS

Officers:

Hon. Treasurer: C. F. HUGHESDON, AFC, FRAeS
Solicitor: L. A. WINGFIELD, MC, DFC (*Hon Companion*)
Secretary: E. M. J. SCHAFFTER, MA, CEng, AFRAeS