ABSTRACTS FROM THE SCIENTIFIC AND TECHNICAL PRESS.

Issued by the
Directorates of Scientific Research and Technical Development, Air Ministry.
(Prepared by R.T.P.)

No. 92. JULY, 1941.

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NOTE.—As far as possible, the country of origin quoted in the items refers to the original source.

LIST OF ABBREVIATIONS OF TITLES AND JOURNALS.

A.	Abstracts from the Scientific and Technical Press.
Aeron. Eng.	Aeronautical Engineering (U.S.S.R.)
Aer. Res. Inst. Tokyo	Aeronautical Research Institute of Tokyo.
A.C.I.C.	Air Corps Information Circular.
Ann. d. Phys.	Annalen der Physik
Army Ord.	Army Ordnance.
Autom. Eng.	Automobile Engineer
Autom. Ind.	Automobile Industries.
Autom. Tech. Zeit. ...	Automobile Technische Zeitschrift.
Bell Tele. Pubs. ...	Bell Telephone Publications.
Bur. Stan. J. Res. ...	Bureau of Standards (U.S.A.) Journal of Research.
Chem. Absts.	Chemical Abstracts.
Chem. and Ind. ...	Chemistry and Industry.
Comp. Rend.	Comptes Rendus de L'Académie des Sciences.
Eng. Absts.	Engineering Abstracts.
E.N.S.A.	Revue Technique de l'Association des Ingénieurs de l'Ecole Nationale Supérieure de L'Aéronautique.
Forschung	Forschung auf dem Gebiete des Ingenieurwesens.
Fuel	Fuel in Science and Practice.
H.F. Technik.	Hochfrequenztechnik und Electroakustik.
Ind. and Eng. Chem. ...	Industrial and Engineering Chemistry.
Ing.-Arch.	Ingenieur-Archiv.
Inst. Autom. Eng. ...	Institute of Automobile Engineers (Research and Standardisation Committee).
J. Aeron. Sci.	Journal of the Aeronautical Sciences.
J. App. Mech.	Journal of Applied Mechanics.
J. Am. Soc. Nav. Engs.	Journal of American Society of Naval Engineers.
J. Roy. Aero. Soc. ...	Journal of Royal Aeronautical Society.

J. Frank. Inst.	Journal of Franklin Institute.
J. Inst. Civ. Engs. ...	Journal of Institute of Civil Engineers.
J. Inst. Elec. Engs. ...	Journal of Institute of Electrical Engineers.
J. Inst. Petrol.	Journal of the Institute of Petroleum.
J. Met. Soc.	Journal of Meteorological Society.
J. Sci. Inst.	Journal of Scientific Instruments.
J.S.A.E.	Journal of Society of Automotive Engineers.
J. Soc. Chem. Ind. (Abstracts B)	Journal of the Society of Chemical Industry (British Chemical Abstracts B)
L'Aéron.	L'Aéronautique.
L.F.F.	Luftfahrt-Forschung.
Luschau.	Luftfahrt-Schrifttum des Ausiandes
Met. Mag.	Meteorological Magazine.
Met. Prog.	Metal Progress.
N.A.C.A.	National Advisory Committee for Aeronautics (U.S.A.).
Phil. Mag.	Philosophical Magazine.
Phil. Trans. Roy. Soc.	Philosophical Transactions of the Royal Society.
Phys. Berichte. ...	Physikalische Berichte.
Phys. Zeit.	Physikalische Zeitschrift.
Proc. Camb. Phil. Soc.	Proceedings of Cambridge Philosophical Society.
Proc. Inst. Rad. Engs.	Proceedings of Institute of Radio Engineers.
Proc. Roy. Soc. ...	Proceedings of Royal Society.
Pub. Sci. et Tech. ...	Publications Scientifiques et Techniques du Ministère de l'Air.
Q.J. Roy. Met. Soc. ...	Quarterly Journal of the Royal Meteorological Society.
R. and M.	Reports and Memoranda of the Aeronautical Research Committee.
Rev. de l'Arm. de l'Air	Revue de l'Armée de l'Air.
Riv. Aeron.	Rivista Aeronautica.
Sci. Absts. (A. or B.)	Science Abstracts (A or B.).
Sci. Am.	Scientific American.
Sci. Proc. Roy. Dublin Soc.	Scientific Proceedings of Royal Dublin Society.
Tech. Aéron.	La Technique Aéronautique.
Trans. A.S.M.E. ...	Transactions of the American Society of Mechanical Engineers.
Trans. C.A.H.I. ...	Transactions of the Central Aero-Hydrodynamical Institute, Moscow.
U.S. Nav. Inst. Proc.	U.S. Naval Institute Proceedings.
Verroffent (Siemens)	Veroffentlichungen aus dem Gebiete der Nachrichtentechnik (Siemens).
W.R.H.	Werft Reederei Hafen.
W.T.M.	Wehrtechnische Monatschefte.
Z.A.M.M.	Zeitschrift für Angewandte Mathematik und Mechanik.
Z.G.S.S.	Zeitschrift für Das Gesamte Schiess und Sprengstoffwessen mit der Sonderabteilung Gasschutz.
Z. Instrum.	Zeitschrift für Instrumentenkunde.
Z. Mech.	Zentralblatt für Mechanik.
Z. Metallk.	Zeitschrift für Metallkunde.
Z.V.D.I.	Zeitschrift des Vereines Deutscher Ingenieure.

German Air Raid Defence of Factoreis. (C. Wachtel, Chemical and Metallurgical Engineering, Vol. 48, No. 4, April, 1941, pp. 92-94.) (92/1 U.S.A.)

It is stated that the author was formerly director of the German Institute of Industrial Hygiene and had been employed by the German and Russian Governments as an expert on the defence of factories against aircraft. Methods of passive defence have formed the subject of serious study on the continent for a number of years. The position of a factory is largely determined by economic conditions (facilities of providing labour and materials, road and rail connections, etc.). No position can be regarded as outside the range of modern aircraft and therefore immune from attack. Decentralisation reduces the risk but slows up production. Much can be done in the proper lay-out of the plant (so-called ribbon arrangement making the fullest use of natural camouflage, such as trees, etc.). Framed structures are generally best and the roof should be sufficiently strong to stop incendiaries. Unfortunately the precautions to be adopted differ radically, depending on whether the bomb explodes inside or outside the building. In the former case, light walls and floors will localise the damage. Heavy walls and roofs are required to withstand blast due to a near miss. The relative risk must therefore be apportioned.

Vital sections of a factory must be placed underground. The same applies to vital stores of fuel, material and finished products. It is stated that such underground storage has been extensively adopted in Germany, by the full utilisation of existing facilities, such as wine and beer cellars, etc., the use of natural cavities such as occur in salt mines, etc., and by the provision of new underground structures. Alternative sources of supply of electric power, water and gas must be available. The same applies to telephone circuits. The author states that Fifth Column activities always present a possible source of danger. This can best be guarded against by harmonious labour conditions, ensuring solidarity between employer and employee. In this case, every member of the staff becomes an alert guard against all types of sabotage.

Atlantic Ferry, U.S.A.-Great Britain. (Inter. Avia., No. 763, 9/5/41, pp. 6-7.) (92/2 U.S.A.)

According to American sources, the possibility of flying medium bombers from Canada to Great Britain was already investigated during the autumn of last year, when experiments were started with the Lockheed Hudson. This aircraft, under normal conditions, has an endurance of ten hours at cruising speed (170 m.p.h.). As a tail wind of 20 m.p.h. can be reckoned on with certainty, the trip should average 11 hours, and with a 33 per cent. margin, a total fuel capacity of 1,200 U.S. gallons and 60 gallons of oil was calculated (2 radial engines rated at 1,100 h.p. each). As the normal useful load of this aircraft is only 6,100 lbs. (normal gross weight 17,000 lbs.), this means an overload of about 2,300 lbs., the wing loading increasing from 31 to 36 lbs. sq. ft. The extra fuel (app. 400 gallons), is stored in flexible rubber tanks, which drain into the main tank and can be discarded when empty. The start is usually made just before dusk and the landing by daylight next morning. Enemy interference is thus out of the question and no armament is carried. A similar procedure has been applied to other medium bombers (Ventura and Maryland), of normal gross weights of 18,500 and 15,300 lbs. respectively. The cruising speed of these machines (with 20 m.p.h. tail wind) is of the order of 220 m.p.h., and the overload required is of the order 2,200 and 3,000 lbs. respectively.

It appears that the larger bombers, such as the Catalina (normal gross weight 30,500 lbs.), and Liberator (normal gross weight 41,000 lbs.), can carry enough fuel for the trip without overloading the machines.

The delivery of fighters in the north of Scotland from Labrador with the help of intermediate stops in Greenland and Iceland, is under consideration. Since no radio help can be expected, the navigation may present difficulties.

Nylon Fibre for the Air Force. (Inter. Avia., No. 760, 16/4/41, p. 9.) (92/3 U.S.A.)

Fabrics manufactured of Nylon artificial fibre, a coal derivative developed by the American chemical concern, E.I. du Pont de Nemours, has been tested over a considerable period by the U.S. Army's Material Division at Wright Field, and compared with pure silk, as a possible substitute for the latter, for use in the manufacture of parachutes. It was found that Nylon Fabrics suffered a greater loss in strength under the effect of ultra-violet rays than silk; however, the tensile strength of Nylon decreased only one-tenth after twenty days of continuous exposure to snow, rain and sunshine, while silk decreased one-third. Exposure to 170 hours of strong sunlight resulted in silk losing 61 per cent. of its tensile strength, while Nylon lost 67 per cent. Since, however, the original tensile strength of the synthetic fabric was considerably greater than silk, and the loss in elasticity under meteorological influences was smaller, the Nylon fibre appears to be at least equally suitable for the manufacture of parachutes as pure silk.

U.S.A. Type Designation. (Inter. Avia., No. 762, 1/5/41, p. 10.) (92/4 U.S.A.)

As is known, the aircraft types ordered by the U.S. Army Air Corps are not designated according to the same methods as those of the U.S. naval air service. The *Army designations* contain a letter marking the class of aircraft, such as " B " for bomber, " P " for pursuits, meaning fighters or interceptors, " PT " for primary trainers, " AT " for advanced trainers, " BC " for basic combat trainers, etc. The figure following this letter designates how many types of this class of aircraft have entered the Air Corps and are given to the new aeroplanes independently of the manufacturers' designation. The designation P-40D indicates, therefore, that the machine is the 40th fighter type of the U.S. Army Air Corps and the fourth version of the prototype P-40. The custom to precede the designation by the letter " X " for the experimental or prototype, and the letter " Y " for the aircraft of the first trial series, is well known, and is employed both by the U.S. Army and Navy. The *type designations of the Navy* are not so clear at a glance because details of the manufacturing company are added to the class designation. The figure preceding the letter denoting the manufacture, indicates how many types of the same aircraft class the manufacturer in question has supplied to the Navy, and the last figure refers to modified versions of the prototype. The designation XSB2C-1, much mentioned in the past few weeks, stands for: Prototype (X) of the second scout bomber (SB2) supplied to the Navy by the Curtiss company (C). Any later version of the same type will be given the designation SB2C-2. Not all manufacturing companies have been assigned a letter corresponding to their own initials; this is due to the fact that the respective letters are reserved to that company of several with the same initial which was the first to supply aircraft to the Navy. From this, certain misunderstandings may result, and therefore the identification letters of the main suppliers are given below in alphabetical order: A for Brewster, B for Boeing, C for Curtiss, D for Douglas, F for Grumman, L for Bell, M for Martin, U for Vought-Sikorsky, and Y for Consolidated.

New Military Types of the R.A.F. and Luftwaffe for 1941. (P. Dublanc, La Science et la Vie, Vol. 59, No. 286, June, 1941, pp. 457-465.) (92/5 France.)

The following types are briefly described.

R.A.F.: Typhoon, Tornado, Whirlwind, Beaufort, Beaufighter, Manchester, Stirling, Fulmar, Botha.

Germany: FW 187 and 189.
Me 115.
He 119.

The Focke-Wulf FW 187 " Destroyer " is an improvement on the Me 110 twin engined fighter. The dimensions of the central fuselage have been reduced by placing the two members of the crew in line instead of side by side. The front seat is occupied by the pilot, a window in the floor of the nose ensuring good ground view. The central fuselage also carries the six fixed guns (two 20 m/m. cannons on the floor and four machine guns, two a side), whilst the nose is armour plated. The charging and maintenance of these guns is carried out by the second member of the crew. The rear gun of the Me 110 has been suppressed. Two DB603 engines are fitted, rated at 1,600 h.p. each.

The FW 189 is a short range reconnaissance machine (3 seater), fitted with two Argus 12 cylinder V air-cooled engines rated at 500 h.p. each. The nacelles are continued towards the rear to carry the tail unit, the machine thus being of the twin fuselage type. The central cabin is amply provided with windows to ensure exceptional visibility. A top speed of over 300 m.p.h. is claimed. The new single seat fighter *Me* 115 has a slightly smaller wing span than the Me 109

(9.5 m. instead of 10 m.). The main difference is in the power plant, the DB603 engine being rated at 1,600 h.p. against the 1,100 h.p. of the earlier DB601 model. A top speed of 640 Km./h. is claimed.

The Heinkel He 119 twin engined bomber has been specially designed to take advantage of the new DB605 engine rated at 2,100 h.p. (24 cylinders). It is not certain whether this power plant is an X engine (2 DB 601), or whether two 2 DB 601 are placed in line, driving contra propellers similar to the Fiat project. It is stated that a bomb load of over three tons can be carried.

The Rôle of the Air Force in the Battle of the Ionian Islands (27-29 *March*). (C. Rougeron, La Science et la Vie, Vol. 59, No. 286, June, 1941, pp. 466-480.) (92/6 France.)

This naval engagement is of special interest, since for the first time, both fleets were provided with reconnaissance and bomber aircraft. Although the Italian ships were more modern and of much higher speed, their weaker armour proved very vulnerable to air attack. It appears that even bombs exploding in the water at some distance distorted the hulls of the Italian vessels to such an extent, that the designed speeds could no longer be maintained. After a chase of some hours, the slower British vessels were able to catch up and with their heavier guns and armour, easily disposed of the enemy. According to the French author, the sacrifice of hull strength for speed is thus very dangerous, for the surface speed of the boat will always remain very much below that of pursuing aircraft, and even the strongest anti-aircraft defence cannot prevent some bombs exploding in the neighbourhood of the hull. Unless therefore, the possibility of aircraft attack can be ruled out, there is no object in designing warships primarily for speed, *i.e.*, at the sacrifice of adequate armour plating of the hull. Aerial attack is likely to be most effective if the aircraft can make use of shore bases, and the author is of the opinion that only very heavily armoured ships should venture into the effective range of such stations.

Emergency Evacuation of Fuel Tanks on Dive Bombers. (La Science et la Vie, Vol. 59, No. 286, June, 1941, p. 517.) (92/7 Germany.)

Dive bombers are liable to forced landings without the pilot having a chance of using his parachute. Such landings, being necessitated by structural damage of the machine by A.A. fire, are likely to be very rough, and the chance of the machine catching fire are correspondingly great. For this reason, the German Ju 88 dive bombers are provided with means for a rapid evacuation of the fuel tank. For this purpose, the tank is provided with a vertical stand pipe reaching almost to the bottom, the upper portion of the tube being continued to the tail of the machine. A control in the pilot's cockpit enables him to subject the petrol to the pressure of the engine superchargers, with the result that the fuel is ejected very quickly.

The Use of Dummies in the Camouflage of Operational Aerodromes. ((E. Z. Yasin, Air Fleet News, U.S.S.R., Vol. 23, No. 5, pp. 423-429.) (92/8 U.S.S.R.)

Dummy figures, buildings, etc., not only permit of masking the presence of aircraft and equipment on the aerodrome, but are also useful to give the field the appearance of being unsuitable for use by aircraft.

Such dummies, *i.e.* mock-ups of the usual local features of the landscape, should be capable of simple construction with the materials to be found on the site, and easily removable, in order not to interfere with the operation of the aerodrome.

Owing to the possibility of discovery by means of stereo-photography, three-dimensional dummies (mock-ups) are usually more suitable than two-dimensional, flat camouflage, although the latter is useful to indicate surface features—roads, paths, ditches, etc.

The preparation of standard camouflage dummies in advance, as part of the operational equipment, is undesirable, as absorbing additional transport, furthermore, standardised dummies will not always match the locality.

Dummy aircraft, which could well be factory produced, appear very effective. They should, however, always be camouflaged themselves, to heighten the deception, and allay suspicions as to their genuineness.

Dummy trees are useful in conjunction with existing woodland or groups of natural trees. Suggestions on their construction and use are given.

Dummy buildings should always conform to the type and style current in the locality. They can be used to mask the presence of aircraft and equipment, as well as to change the appearance of the aerodrome. They should be simply constructed, of local materials, and easily removed.

Dummy groups of animals are particularly suitable for masking the character of the aerodrome. They can be used on runways, and quickly removed in case of need. It is sufficient for the dummy to represent roughly the outlines of the animal as seen from the air, and extreme adherence to detail should be avoided. Data on the necessary materials and labour are furnished.

Stacks and ricks are extremely suitable as dummies.

Flat two-dimensional camouflage to indicate cultivated ground, roads, etc. is very suitable for combined use with the foregoing. It can be made to remain in place when runways are in use, and is usually not worth retaining for re-use on another site; it should, therefore, be of the simplest and lightest materials.

Sketches and photographs illustrate the proposals made in the text.

Oxygen Equipment of German Aircraft. (N. P. Egorov, Air Fleet News, U.S.S.R., Vol. 23, No. 5, pp. 448-455.) (92/9 U.S.S.R.)

The article describes the " Auer A-824 " type of oxygen apparatus which is standard for the Luftwaffe. A preliminary sketch of the systems of charging the oxygen cylinders in the aircraft—directly, from a mobile charging unit (preferred by the Luftwaffe), or from a stationary charging unit on the aerodrome. A description is given of the oxygen pumps employed for both methods.

After a detailed description of the " A-842 " oxygen apparatus and its mode of operation, the conclusion is reached that the sole disadvantage is the necessity for manual operation of the valve for the supplementary airfeed.

Progress and Prospect in Aircraft Production in the U.S.A. (J. H. Jouett, President, Aeronautical Chamber of Commerce, Aut. Ind., Vol. 84, No. 10, 15/5/41, p. 515.) (92/10 U.S.A.)

U.S.A. aircraft manufacturers to date have been asked to build about 44,000 military aircraft, roughly distributed as follows:—

16,500	U.S.A. Army
8,500	U.S.A. Navy
16,000	Great Britain and Canada
3,600	bombers (Knudsen Plan)

The bulk of these orders have been placed since the autumn of 1940, and 7,000 'planes have so far been delivered. Since the outbreak of the War, 3,500 military aircraft have been supplied to Great Britain. The following production figures are quoted:—

November 1940	700	'planes	
December 1940	800	,,	
January 1941	1,000	,,	
March 1941	1,200	,,	
Summer 1942	2,400	,,	(estimated)
Total estimated output 1941	18,000	,,	
,, ,, ,, 1942	30,000	,,	

It is stated that a medium bomber consists of 30,000 parts, exclusive of bolts, nuts and rivets. These parts are worked into 650 sub-assemblies and these in turn into 32 major sub-assemblies, before the aircraft is finally assembled. The total labour involved amounts to 30,000 man hours per machine. The author concludes that even now, half the U.S.A. output, coupled with the British output, exceeds the Axis production.

Recent Air Corps Developments in Rotating Wing Aircraft. (H. F. Gregory, J. Aeron. Sci., Vol. 8, No. 8, June, 1941, pp. 331-333.) (92/11 U.S.A.)

The YG-1B Autogiro was not found suitable for needs of Army co-operation because of:

1. Tricky handling characteristics.
2. Insufficient landing and take-off performance.
3. Excess pilot fatigue.
4. Insufficient load carrying capacity.

The recommendations as a result of these tests were:

1. Development of high-performance low-speed airplane.
2. Improved performance of the autogiro.

The Air Corps developed the high-performance low-speed airplane known as the O-49, YO-50 and YO-51. It also carried on developments in the nature of improvements of the YG-1B Autogiro. These improvements covered the following features:

(*a*) Constant Centre of Pressure Rotor Blades.
(*b*) Accelerated Take-off Mechanism.
(*c*) Improved Rotor Starter.
(*d*) Direct Take-off.
(*e*) Flexible Pylon Mount.
(*f*) Installation of Larger Engine and Constant-Speed Controllable-Pitch Propeller.
(*g*) Flexible Landing Gear.

An aerodynamic investigation of a feathering control system is under way. So far, control of Army autogiros has been effected by tilting of the rotating mass. The feathering control system will vary the pitch of the blade cyclically for control. Ease of control, lessening of pilot fatigue, and improvement of vibration characteristics are expected.

The Air Corps is also engaged in the development of the helicopter. It is reasonable to predict a promising future for this type of craft.

The Use of A.A. Artillery in Aerial Warfare. (A. Fournier, La Science et la Vie, Vol. 59, No. 286, June, 1941, pp. 498-507.) (92/12 Germany.)

Experience has shown that aircraft operating at altitudes of the order of 6,000 m. is practically immune to A.A. fire of the heaviest calibre (88 or 94 mm.). Even if the calibre is pushed to 150 mm., the bomber need only rise to 8,000 m. in order once more to be practically safe. This applies in the daytime, when the predictor gear can be operated visually under optimum conditions. At night time when only sound detectors can be used, A.A. fire at these altitudes simply means a waste of ammunition. According to the author, the mere pressure of powerful A.A. batteries serves however a useful purpose by reminding the adversary that a descent into lower altitude will be risky. Occasional bursts of fire is all that is required for this purpose. It produces the same results as a continuous barrage without the prohibitive cost in ammunition and wear of the guns.

Summing up, the author concludes that whilst the A.A. cannot prevent an attack, the chances of an important target surviving are considerably increased due to the inaccuracy necessarily associated with high altitude bombing.

Speed and Ceiling of Bombers. (C. Rougeron, Inter. Avia., No. 768-769, 16/6/41, pp. 1-4.) (92/13 France.)

Whilst the importance of high speed has been fully recognised for some time and adequately provided for by the designer of modern fighter aircraft, the corresponding advantages of a high ceiling are only lately receiving attention. This tardy development is partly due to the difficulty of ensuring adequate protection of the crew against the harmful effects of altitude. In the case of bombing aircraft it was moreover feared that the accuracy of bombardments carried out from altitudes in excess of 20,000 feet would suffer unduly. It must however be remembered that the high speed of modern aircraft has already affected the bombing from quite moderate altitudes and the increased ceiling will not make matters much worse. In any case, increased dispersion can be allowed for by proper choice of targets. The physiological effects of altitude on the crew can be kept within reasonable bounds by provision of pressure cabin or suits, combined with training and medical supervision. It appears that progress in the latter direction is most urgently wanted. In the author's opinion, the field of high altitude flying has been sadly neglected by the military authorities of all countries. The air force which will solve this problem first so as to operate effectively large formations at a greater altitude than the enemy will obviously have scored a great tactical advantage.

In the words of the author: "There is no lack of targets promising a sufficient efficacy of hits even from altitudes of 66,000 feet."

Visualised Aerodynamic Research by Means of a Smoke Tunnel. (R. W. Griswold, S.A.E. Journal, Vol. 48, No. 5, May, 1941, pp. 180-187.) (92/14 U.S.A.)

The tunnel is of the non-return-flow type, which design is dictated by the need for continuous supply of fresh air when smoke lines are injected into the flow. The test area, which is spanned by the model so as to give two-dimensional flow, has a high narrow rectangular cross-section. A heavy plate glass window is mounted flush with the internal surface in the front face of the tunnel to expose the model to view, with a field of 24 streamlines.

The power plant consists of a centrifugal blower, belt-driven from a model A Ford engine, with which combination air speeds up to 80 m.p.h can be attained. Exhaust heat from this engine is utilised to activate the smoke-supply apparatus. Smoke is generated by smouldering rotten wood in a special type stove.

With this equipment, a variety of model changes and modifications can be provided, the principal flow characteristics of which can be explored in a fraction of the time (and thus expense) and, in certain respects, more thoroughly than is normally the case for the less flexible three-dimensional quantitative tests. This tunnel is by no means a substitute for the latter equipment, but it already has proved to be a useful and convenient piece of supplementary equipment for preliminary and exploratory flow research concerned with aerodynamic problems susceptible to two-dimensional investigation. Photographic reproductions of a large number of typical flow patterns are given.

Note on the Method of Successive Approximations for the Solution of the Boundary Layer Equations. (J. H. Preston, Phil. Mag., Vol. 31, No. 209, June, 1941, pp. 452-465.) (92/15 Great Britain.)

A method of successive approximations was developed for the flow past a flat plate at high Reynolds numbers by Piercy and the present author in a previous paper. The first approximation corresponded to the asymptotic solution for Oseen's approximation, whilst the sixth was very close to the Blasius solution; thus in this case the convergence was satisfactory.

The method was generalised in a second paper by Piercy, Whitehead, and the present author. In this paper, solutions were restricted to cases where the pressures were those of the ordinary potential flow, or of a modified potential flow, obtained by introducing a crude representation of the wake.

The original purpose of the present note was to remove this restriction so that the method could be applied to cases where it was necessary to use experimental pressures.

Whilst satisfactory values of the skin friction may be expected in the region of accelerated flow for a limited number of approximations, it appears that in the retarded region, a large number of approximations will be required, and that even then a position of the breakaway may be uncertain.

The Elliptic Wing Based on the Potential Theory. (K. Kriens, Z.A.M.M., Vol. 20, No. 2, April, 1940.) (R.T.P. Translations T.M. 971.) (92/16 Germany.)

The present report deals with the elliptical wing in straight and angular flow on the basis of the potential theory. Conformably to the theory of first approximation upon which the calculation rests, the known requirements regarding the shape of the surface and its angle of attack must be met. A further condition is that the slope of the surface toward the streamlines must be a continuously differentiable function of the points of the surface. If this is not the case (for instance, by aileron deflection or wing dihedral—the latter being of importance in slideslips), the discontinuities must be replaced by suitable rounding off. In general, the calculation of a given elliptic surface requires a series of infinitely many potential functions, the co-efficients of which are afforded from linear infinite systems of equations. The expansion is stopped with a certain term, depending upon the degree of accuracy desired.

It may be mentioned that the computed potential and downwash functions change on transition to $K^2 \rightarrow 0$ (*i.e.* equality of elliptic axes), into Kinner's functions for the circular wing.

A large portion of the computations were made on the calculating machine, the accuracy of the slide rule being insufficient in the calculation of the elliptic integrals of higher order.

On the Subsonic Flow of a Compressible Fluid Past a Symmetrical Joukowski Aerofoil. (S. Tomotika and H. Umemoto, Aer. Res. Ints., Tokyo, Vol. 16, No. 205, March, 1941, pp. 35-125.) (92/17 Japan.)

In the present paper, the two-dimensional irrotational subsonic flow of a compressible fluid past a symmetrical Joukowski aerofoil placed at an arbitrary inclination to the direction of the undisturbed stream has been re-investigated in detail, with the special intention of studying the manner in which the value of the so-called critical Mach number for the symmetrical Joukowski aerofoil varies with the angle of attack as well as with the thickness ratio of the aerofoil.

The method first suggested by Poggi (1937) and subsequently described by Kaplan (N.A.C.A. Reports 621 to 671) has been employed. One of the interesting results obtained is that when the angle of attack takes any value different from o°, the curve of the critical Mach number plotted against the thickness ratio t, has a maximum at a certain definite value of t. This feature seems to be worthy of special notice.

It is found that when the value of the angle of attack is fixed, the value of the ratio L_c/L_i for given symmetrical Joukowski aerofoil increases as the Mach number increases and also that the value of L_c/L_i for a definite Mach number increases slightly, with increasing angle of attack, where L_c denotes the lift which a symmetrical Joukowski aerofoil of a given thickness ratio experiences when placed in a stream of compressible fluid, and L_i the lift which the same aerofoil would experience when placed, at the same angle of attack as before, in the incompressible fluid flow.

In conclusion, the authors discuss briefly the validity of Glauert-Prandtl's approximate formula for the ratio L_c/L_i.

Supersonic Flow Studies. (T. Ackeret, Inter. Avia., No. 768-769, 16/6/41, pp. 9-10.) (92/18 Switzerland.)

Reference is made to experimental studies of supersonic flow carried out at the Swiss Federal Institute of Technology (Zurich). Striation photographs taken at M=.86 show separation of the boundary layer starting at about one third of the wing chord from the nose of a symmetrical aerofoil. This point is also marked by the presence of a small shock wave, inclined as usual towards the rear, the so-called Mach angle. The photographs are of special interest in showing the developments of a second shock wave of much greater intensity, emanating from the now separated boundary layer (at app. two-thirds chord), and spreading to a considerable distance at right angles to the wing on either side. The inclined shock wave, starting at the point of separation, meets this second wave, and direct measurement with a pitot tube shows that supersonic velocities are found throughout the triangular space so formed. Direct measurements also indicate that the wing surface pressure in the shock region is of the order of .6 adiabatic compression pressure. At this Mach Number (.86), the drag co-efficient of the aerofoil is about 7½ times the normal (low speed) value, the first increase becoming marked at M=.75. Whilst very thin aerofoils delay this separation of the boundary layer to some extent, their employment meets with practical difficulties. The possibility of boundary layer control by suction is being investigated. If feasible, the drag increase normally associated with such high speed flight could be reduced.

The Nose Wheel Landing Gear. (Inter. Avia., No. 715, 24/4/41, pp. 1-5.) (92/19 Switzerland.)

The employment of landing flaps required the pilots to abandon their earlier landing techniques. The approach glide for the landing had now to be made with the longitudinal axis of the aircraft in a more or less forward-inclined position, and the change in the angle during flattening out, and stall was doubled. The logical thing was, therefore, to develop a landing gear in which the final position of the aeroplane on the ground corresponded more closely to the landing inclination. Thus, the way was paved for the nose-wheel landing gear, and to-day, practically all new commercial and military aircraft produced in the United States are fitted with the nose-wheel.

Since in the tricycle undercarriage the nose wheel is mounted far in front of the centre of gravity, the danger of a nose-over is completely eliminated, and full brake power can be applied immediately after touching down, as a result of which the approach glide for the landing need not necessarily be made at the minimum speed, and the dependency of the landing distance from the gliding speed is reduced. If a downward motion still exists upon touching down, it will not result in the aircraft jumping off again, no matter if the nose-wheel or the main wheels touch down first, as on the one hand the location of the centre of gravity equally favours the touching down of all three wheels and, on the other hand, the wing has a smaller angle of incidence in the taxi-ing position than in the glide. Even when the tricycle aeroplane is flattened out at a great angle of incidence, the touching down of the main wheels immediately causes the nose-wheel to touch down also and, thus, a decrease of the angle of incidence. In drift landings or crosswind landings, the brake power of the main wheels creates a stabilizing moment which maintains the aeroplane's longitudinal axis in the landing direction, so that also in this case the danger of a lateral tip-over or a turning away from the landing direction is avoided.

Additional advantages of the nose wheel under-carriage are: Considerably improved vision for the pilot during take-off, landing and taxi-ing; simplified start, as the aeroplane already assumes the position offering the smallest frontal area, and the longitudinal axis of the aeroplane must not first be brought into the horizontal position by movements of the control column; finally, increased comfort for the passengers of commercial air-liners due to the fact that the longitudinal axis of the fuselage is practically constant during take-off and landing, and in level flight.

The main disadvantage of the nose wheel landing gear is an increase in the gross weight. This is explained by the fact that the main wheels must be designed for loads at least equal to those for which the main wheels of the conventional undercarriage are built. Even to-day, no generally valid load data for the calculation of the tricycle landing gear are available; in any case, however, the possibility of higher landing and taxi-ing speeds requires more rugged and therefore heavier designs. The major portion of the weight increase is furnished by the nose-wheel itself, which must be capable of withstanding the heavy loads resulting from the sudden braking of the main wheels, and must be connected with the rudder control. This requires a strengthening of the fuselage nose, which ultimately results in an increase of the weight of the entire tricycle installation by 50 per cent. over that of the tail-wheel landing gear.

It is quite possible that the universal adoption of the nose-wheel landing gear will profoundly affect the design of new types, inasmuch as it will be attempted to free the nose for the front wheel by shifting the power plant to the centre portion of the fuselage or by substituting pusher designs. It would appear that considerations of this kind have strongly influenced the development of the Bell P-39 "Airacobra" fighter, all the more as the unobstructed space in the fuselage nose was required also for the armament installation.

A disagreeable feature of the tricycle landing gear is formed by the shimmying tendency of the steerable nose wheel, discernible at certain speeds both at take-off and on landing.

Exhaustive tests conducted by the N.A.C.A. are ample proof that an improvement of these detrimental feaures is being sought. The main difficulty of the problem appears to lie in the fact that the nose-wheel shimmy should be eliminated without impairing the steerability of the wheel. Tests have shown that the effect of the type of tyre or tyre pressure is negligible, that the caster angle and spindle moment of inertia, influences the damping force, and that the shimmy of nose wheels of big aeroplanes cannot be prevented solely by solid friction damping.

Everything considered, the advantages of the nose wheel landing gear appear far to outweigh the disadvantages. The main improvement, which coincides with the general trend towards higher wing loadings, is indicated by the possibility to land aeroplanes at speeds in excess of the minimum flying speed without requiring any considerable lengthening of the landing run.

Developments in Goodrich De-Icer. (Inter. Avia., No. 761, 24/4/41, p. 14.) (92/20 U.S.A.)

The new patent, No. 2,237,175 of the B.F. Goodrich Company of New York, covers an improvement of the well-known Goodrich De-Icer system which prevents the accretion of ice at the critical points of the aeroplane mechanically, by means of pulsating rubber "overshoes." The overshoe is faired to the wing by means of a metal strip on which the ice formed could not be removed. The improvement on the method so far in use, consists of a secondary layer of soft rubber which is attached on the main de-icer, and is stretched taught over the common attachment strip. Every pulsation of the "primary" de-icer is communicated to the "secondary" overshoe and prevents the formation of ice also in the hitherto unprotected region.

American Society of Aeronautical Weight Engineers. (Inter. Avia., No. 761, 24/4/41, p. 15.) (92/21 U.S.A.)

The American Society of Aeronautical Weight Engineers has been formed for the purpose of standardising the weight indications of aircraft and simplifying the weight checking of production aeroplanes required by the delivery committees. In order to simplify the delivery formalities, it was agreed to eliminate weighing of aeroplanes in the gross weight condition, except on the first machine of a contract. Formerly the Army and Navy required that the 1st, 5th, 10th, 20th, and each succeeding 20th aeroplane of a contract be weighed in the gross weight condition. A reduction in weight empty weighings was also agreed upon; now only the 1st, 10th, 25th, and one out of each succeeding 100, as well as the last aeroplane of a contract are required to be weighed in the weight empty condition. Besides similar simplifications in the weighing of nose-wheel aircraft and flying boats, the society reached an agreement for free interchange of weight data for estimating purposes.

Douglas Method of Flush Riveting Thin Sheets for Aircraft. (Aut. Ind., Vol. 84, No. 10, 15/5/41, p. 518.) (92/22 U.S.A.)

The rivet has a cylindrical shank 3.1 mm. diameter with a conical head of 100° taper and 5.50 mm. maximum diameter. A very shallow cylindrical crown (depth 0.15 mm.) is provided on the head and this is stated to ensure a tighter fit during the subsequent closing process. The original volume of the head is 18.6 cu. mm. and the ratio of the original diameter to the original height is 4.78.

In setting the rivet, it is first inserted into the hole in the sheets with the shank extending into a tubular "bucking tool," the upper end of which is countersunk at 110.8°. One or two blows of the hammer (impact of the order of 11 ft. lb.) suffice to dimple the sheets and seat the rivet. During this operation the head diameter is increased to 6 mm. and the height reduced from 1.15 to 1 mm. The volume of the new head is now 16.9 mm. and the diameter/height ratio is increased to 6.0.

The final step consists in upsetting the shank of the rivet by a series of blows of a riveting hammer fitting snugly inside the cylindrical portion of the bucking tool. During this operation the dimpling hammer rests on top of the rivet head and acts as a countermass.

Some Experimental Results on Wing Flutter. (W. Bollay and C. D. Brown, J. Aeron. Sci., Vol. 8, No. 8, June, 1941, pp. 313-318.) (92/29 U.S.A.)

The present paper represents a progress report of some experiments being carried out in the aerodynamics laboratory of Harvard University. The first part of the experimental investigation consisted in the measurement of the vibration response curves of a wing in the wind tunnel. A wing, free to vibrate in bending and in torsion, was subjected to a forced vibration at various air speeds up to the flutter speed. These measurements are of interest in that they show how the two natural frequencies of the wing come together as the flutter velocity is approached. The peaks of these response curves are also of interest in that they determine the maximum stresses which are experienced, for instance, by a propeller which is subjected to periodic impulses from the engine.

The second part of the investigation deals with the problem of flutter above the stall. Measurements show that at angles of attack above the positive stalling angle and below the negative stalling angle the flutter speed is decreased to less than one-third of the flutter speed of the unstalled wing. This flutter seems to be associated with an instability which arises when the slope of the lift curve becomes negative. Experiments on a metal wing supported as a cantilever indicate that the flutter at the stall may also be associated with an excitation from a system of Kármán vortices.

The Proportioning of Aircraft Frameworks. (N. J. Hoff, J. Aeron. Sci., Vol. 8, No. 8, June, 1941, pp. 319-324.) (92/30 U.S.A.)

A routine procedure, consisting of three steps, is presented for calculating the stresses in and the stability of plane frameworks. In the first step the preliminary sizes and gauges of the bars are chosen upon tentative assumptions for the end-fixity. In the second, the assumptions made are checked by rational approximate methods. In the third and last, the final check of both stresses and stability is obtained in a single step by the use of James's version of the Hardy Cross method of moment distribution. It is suggested that the procedure here described be denoted the Lundquist-Stanford method of proportioning frameworks as distinct from the Lundquist method of determining critical loads.

The Effect of Design Variables on Cargo Plane Performance. (A. Burstein, J. Aeron. Sci., Vol. 8, No. 8, June, 1941, pp. 325-330.) (92/31 U.S.A.)

The possible development of an air freight system in the United States brings up the relationship of aerodynamic design to the economical operation of cargo planes. It is shown that a careful analysis, in the light of operating costs and safety of all factors entering the design of an aeroplane is essential, if a sound design is to be evolved.

A method of evaluating the major design variables is presented. It is also shown that the operation of the plane and the degree of safety desired must be decided upon before proceeding with a design.

Because of the broad scope of the investigation, the results presented should be considered qualitatively only. However, definite trends are indicated. No fundamental aerodynamic difference exists between a well designed cargo plane and a passenger plane.

"Peravia" Engine Load Recorder. (Flugwehr and Technik, Vol. 2, No. 7, July, 1940, p. 155.) (92/32 Switzerland.)

It is customary to overhaul aero engines after a certain number of flight hours as recorded in the log book. This method of estimating the condition of the engine has the disadvantage that it is based on operation time only and no account is taken of the actual load conditions during the period. In other words, half-hour cruising is rated as equivalent to half-hour under maximum boost and this may lead to the engine being stripped when still in serviceable condition. Moreover, the checking of the log books may be difficult under war conditions and in any case requires responsible personnel. For this reason, the Peravia firm have brought out an instrument which records automatically not only the time of operation but also the induction pipe pressure. Details of the load recorder are not given, but it appears to be an engine revolution counter in which the gearing is affected by the boost pressure. Engine overhaul becomes necessary when the five-figure counter reaches a certain number.

Engine Design v. Lubrication (with Discussion). (R. J. S. Pigott, S.A.E. Journal, Vol. 48, No. 5, May, 1941, pp. 165-176.) (92/33 U.S.A.)

Attention is called to the increase in severity of conditions for lubrication in the last few years, during which the engine designer has been calling upon the oil chemist for special oils to correct difficulties in operation. The 5 per cent. increase in horse-power obtained during the last ten years is proportioned between increase of compression ratio, intake system, displacement, and speed. Increase in severity of mechanical and thermal loading is due both to increase of rotative speed and brake mean effective pressure. Cooling done by the oil has been increased, and pistons are hotter than formerly. Crankcase temperatures have risen.

Although compounding delays the start of deterioration and lowers the absolute rate, it does not prevevnt deterioration of the oil.

Too many engineering problems recently have been left to the chemist to solve. Several cases of lubrication difficulty are discussed, and a method of analysis is described which shows accurately what any oiling system will do, and can locate most of the troubles. The general fault nowadays is too low an oil flow over the bearings for cooling and unnecessarily high crankcase temperatures.

Compounded oils are bound to increase in the future, but ultimately each must cover a much wider range of usefulness than any present single oil covers. A short discussion is given on means for increasing brake horse-power without increasing the octane rating of the engine fuel.

Experimental Investigations on Freely Exposed Ducted Radiators. (W. Linke, Jahrbuch D.L.F.F., Vol. 2, pp. 381-386.) (R.T.P. Translation T.M. 970.) (92/34 Germany.)

The present report deals with the relation between the open areas, the drag, and the air flow as observed on freely exposed ducted radiators (*i.e.*, no body interference)—the air conductivity being modified from zero to one unit. The most advantageous forms of ducts are derived therefrom.

In conjunction with theoretical results, the individual components of the drag of ducted radiators are discussed and general rules established for low-loss ducts. The influence of the wall thickness of the ducts, of the length ratio of the exit, and the effects of sonic velocity on diffusers are dealt with by special measurements.

Use of Charts for Flow Discharge Calculations. (Lutz, O., L.F.F., Vol. 17, No. 8, 26/10/40, pp. 332-335.) (R.T.P. Translation T.M. 972.) (92/35 Germany.)

Various problems in connection with engine design involve flow discharge calculations which are rendered difficult both on account of the large number of external variables that enter into the computation, *i.e.*, changes in discharge area during the process, change in volume of the cylinder, pressure, etc., and changes in the thermal constants themselves of the flow medium. A fairly accurate solution that does not involve an excessive amount of labour can be obtained only through the extensive use of *I-S* tables (total heat-entropy). In the present report a simplified solution based on the tables of Lutz and Wolf is described.

Calculation of Resonance Vibrations of an Elastically-Supported Engine Mounting. (E. V. Ananiev, N. P. Serebriansky, P. G. Timofeev and A. E. Pankratov, Aeron. Eng., U.S.S.R., Vol. 15, No. 4, April, 1941, pp. 21-40.) (92/36 U.S.S.R.)

Particularly large vibrations of an engine propeller group, accompanied by correspondingly high stressing, occur under conditions of resonance, *i.e.*, when the frequency of the inciting impulses corresponds with the natural vibration frequency of the engine mounting. By the use of flexible mounting the natural frequency of the engine mounting can be reduced below the range of possible frequencies of the inciting forces, the latter including inertia and aerodynamic forces on the propeller. The inertia forces causing vibration comprise static and dynamic unbalance, lashing of the propeller shaft in its bearings and the gyroscopic moment of a two-bladed propeller. The aerodynamic forces are due to difference in setting angle of the blades. Static and dynamic unbalance and also difference in blade setting angle cause impulses of frequency equal to the speed of revolution of the airscrew; the gyroscopic effect causes vibrations of a frequency double that of the airscrew speed. Vibrations due to the actual engine are essentially those produced by the individual cylinders, their frequency being double the crankshaft speed. Impulses due to the gas pressure may have different frequency, the lowest being half the crankshaft speed. Frequencies of the highest orders will be n, $1.5\,n$, $2\,n$, $2.5\,n$, etc., where n=crankshaft speed. Consequently greatest effectiveness is obtained from the elastic mounting if the following recommendations are observed:—The natural frequency of torsional vibration of the engine mounting about the axis of thrust must be lower than half the crankshaft speed, and the remaining five frequencies must be lower than the crankshaft speed, or, for an engine with reduction gearing, lower than the propeller speed. In the present paper the formulæ deduced for calculating the natural frequency are obtained by considering the engine as a solid body on elastic supports with six degrees of freedom, *i.e.*, three motions in the direction of the three main axes and three corresponding rotations about the same axes. Calculations are made for in-line and radial engines.

Effect of Temperature and Pressure of Induction Air on the Operation of an Aero Diesel. (A. E. Tolstov and D. A. Portnov, Aeron. Eng., U.S.S.R., Vol. 15, No. 4, April, 1941, pp. 41-53.) (92/37 U.S.S.R.)

Very little work has been carried out so far on the effect of supercharging on Diesel performance. The most comprehensive appears to be that of C. S. Moore and J. H. Collins (N.A.C.A. Tech. Note No. 619, 1937), but the method of investigation employed cannot be considered satisfactory since the tests were made at high fuel consumptions and at excess air coefficients (0.6 to 1.1) which are not characteristic of Diesels. In addition it is not possible from the results obtained to evaluate the effects of the individual parameters defining the condition of the induction air.

The purpose of the present work was to obtain more detailed information on the fundamental factors governing the working process in a four-stroke aero Diesel engine with supercharger and to determine experimentally the effect of a variation of the temperature and pressure at induction. The tests were made on a single cylinder air-cooled four-stroke engine, with compression ratio 14. Some preliminary conclusions are as follows:—

1. When running at constant speed and constant exhaust back pressure and fuel consumption, the brake horse-power decreases with increasing pressure of the induction air. Variation in air temperature over a fairly wide range (70-120°) had only a slight effect and for practical purposes this effect may be neglected.

2. Variation in density of the induction air has a decisive effect on the variation in mean indicated pressure, indicated fuel consumption, exhaust temperature and pressure in the combustion chamber at constant fuel consumption; this effect is independent of the cause of change in air density (pressure or temperature).

3. Increase in supercharger pressure at constant temperature improves the charging process. The volumetric efficiency increases sharply at first, and with further increase in pressure slowly approaches its maximum. Increase in induction pressure at constant fuel consumption and constant induction temperature improves the dynamics of the cycle by lowering the rate of pressure rise and reducing the thermal loading of the combustion chamber walls and piston on account of better flow through the cylinders.

4. Increase in temperature of the induction air at constant fuel consumption and constant pressure has a deleterious effect on the working process, increasing the temperature of the exhaust and reducing efficiency.

At constant excess air coefficient a temperature increase of 10° causes a decrease in mean indicated pressure of about 3 per cent.

1940 *C.F.R. Road Detonation Tests.* (J. M. Campbell and others, S.A.E. Journal, Vol. 48, No. 5, May, 1941, pp. 193-204.) (92/38 U.S.A.)

The 1940 CFR Road Tests have developed new information that can be used for the development of fuels and engines. Application of the principles worked out in these tests is expected to result in a more efficient utilisation of fuel anti-knock properties and more effective engine design and adjustment to meet the requisites of current motor fuels.

These tests indicate that the ASTM octane number alone, or even a road octane number as determined by methods heretofore widely used, does not give sufficient information for present needs relative to fuel behaviour in service. Neither do test methods previously used provide sufficient information concerning the fuel requirements and knocking characteristics of engines. The new methods of approach which have been developed, furnish needed information relative to the fuel and engine relationship that heretofore has been obscure, and indicate paths for future developments.

The entire programme has been supported generously by the co-operating organisations and their respective representatives, who actively participated in the tests. Various phases of the work have extended over most of the past year and, in the concluding and most important stage—the centralised road tests at San Bernardino, Calif.—32 organisations were represented. In these concluding tests, a study was made of the characteristics of 23 fuels, representing a wide variety of fuel types, and the complementary behaviour of 24 different automobiles. During this latter period alone, the 24 test cars were driven over 100,000 miles.

Development Work on the "Bulldog" Tractor Operating on Wood Gas. (K. Kunzel, A.T.Z., Vol. 44, No. 6, 25/3/41, pp. 149-155.) (92/39 Germany.)

The well-known "Bulldog" tractor manufactured by the firm of Lanz is fitted with a single cylinder two-stroke hot bulb engine, using crankcase compression.

Almost any type of liquid fuel can be used, provided the compression ratio is suitably adjusted. For this purpose interchangeable cylinder heads are provided.

Early experiments with wood gas fuel showed a serious drop in power (about 30 per cent. below that obtainable with fuel oil). In addition, after only forty hours operation, the engine required cleaning due to excessive crankcase deposits. This latter difficulty was completely overcome by so altering the inlet circuit that the scavenge pump in the crankcase handled air only. For this purpose, a suitable capacity was introduced into the connecting channel between cylinder and crankcase, and the automatic mixture inlet (flap valve) was placed close to the cylinder inlet.

The drop in power compared with fuel oil operation was completely avoided by injecting a small quantity of fuel oil into the cylinder (pilot ignition), and using this to fire the main charge. In the case of a 25 h.p. tractor, the quantity of oil required for this purpose is of the order of 1 Kg./hour only, the wood consumption in the generator being about 23 Kg./hour.

Abstract Note.

The use of oil pilot ignition in combination with generator gas has also given excellent results in ship propulsion, see W.R.H., Vol. 22, No. 1, Jan. 1941, pp. 41/43.

Some Peculiarities in the Working of Aircraft Fuel Systems. (G. K. Volkov, Air Fleet News, U.S.S.R., Vol. 23, No. 5, pp. 442-444.)

Operation of Aircraft Fuel Systems at High Altitudes. (M. P. Fokier, Air Fleet News, U.S.S.R., Vol. 23, No. 5, pp. 445-447.) (92/40 U.S.S.R.)

Both articles deal with the problem of vapour locks in fuel systems, giving rise to irregular running, especially at altitude.

After discussing the conditions of occurrence of vapour locks, with particular reference to the influence of accelerations in unsteady flight, the requiremont is set up that the fuel system should be previously checked for correct operation under all likely conditions of flight.

The second article deals more particularly with experiments made by P. A. Pybakov on the causes of uneven running at altitude, which was found to be due principally to vapour locks in the fuel system.

The conclusion is arrived at, that vapour locks at altitude are caused principally by excessively high temperature of the fuel as taken in on the ground, in conjunction with the relative vapour tension of the fuel. Fuel grades of a vapour tension between 270-330 mm. mercury at 38°C., are considered safe from vapour lock at normal altitudes of present-day flight. It is, however, necessary to ensure that the fuel is not excessively heated while stored on the ground.

High Speed Tension Tests at Elevated Temperatures. (A. Naidai and M. J. Manjoine, J. App. Mech., Vol. 8, No. 2, June, 1941, pp. 77-91.) (92/43 U.S.A.)

The resistance to plastic deformation of several metals was investigated over a wide range of the rates of deformation and at various temperatures. The influence of the rate of strain on the forces required for plastic forming, was explored in tension tests. The fastest rate of stretching was one billion times larger than the slowest speed. At the highest velocity, corresponding to a tension test of the duration of 0.001 sec. and at temperatures close to the melting point, a remarkably large resistance to deformation was observed. In general, the stresses decrease with the temperature and increase with the rates of straining. For some ferrous metals, including a very pure iron, the resistance to deformation shows a well-defined maximum and minimum of stress as a function of the temperatures for a given strain rate. It was found that for these ferrous metals, the temperature range in which the maximum of the strength occurs, depends upon the rates of stretching. At slow rates it occurs around 200°C., while, at the very fast rates of stretching, the maximum strength is observed at 550°C. Curves showing the dependence of the resistance to deformation upon the strain rates and the temperature, are given for several metals.

In a high-speed tensile test of pure iron, an instantaneous temperature rise of about 50°C. was observed, due to the conversion of the work of deformation into heat.

It appears possible, at least in the higher range of temperature, to predict the shapes of the stress-strain curves in tension tests and the characteristic contours of bars in their necked portions. These predictions are based on a few simple assumptions as to the probable form of the relations connecting stress and the rates of strain, and are in agreement with some of the corresponding observations made at the higher testing temperatures.

Effect of Surface Finish. (J. T. Burwell and others, J. App. Mech., Vol. 8, No. 2, June, 1941, pp. 49-58.) (92/42 U.S.A.)

Surface finishes produced in various ways having roughnesses ranging from 130 to 1 micro-inch, as measured by their root-mean-square deviations from a median plane, have little or no effect on the performance of a partial journal bearing while it is operating under hydrodynamic lubrication. There is general agreement with theory in this region, but the agreement is improved if account is taken of the breaking of the film near the outlet end of the bearing.

The lower limit of the region of hydrodynamic lubrication for a given journal-bearing combination as indicated by the minimum in the friction-co-efficient curve, is markedly dependent on the surface finish of the journal. The load capacity of the bearing increases with increasing smoothness and emphasises the great importance of reducing the surface roughness to less than 15 micro-inches at least.

A sensitive method of determining iron in oil has been developed, involving the extraction of the iron from the oil by means of hydrochloric acid. This permits the determination of 1 part of iron in 10^7 parts of oil. This method was applied to the study of the wear of a journal-bearing combination.

The effect of pressure on the running-in process was studied while maintaining a constant surface finish. The results indicate that the wear at the end of two hours increases with pressure, for the pressure range up to 1,000 lbs. per sq. in. under the ruling test conditions.

The effect of surface finish on the running-in process was measured at constant pressure. A remarkable straight-line relationship exists between the total wear at the end of two hours and the degree of surface finish, at the constant pressure employed.

It was found that the running-in period takes place in a short time, of the order of one half to one hour. The initial rate of wear is high and falls off fairly rapidly. In all cases the quantity of metal removed was quite small, being less than a millionth of an inch if it could be considered as being removed uniformly.

Analysis of Spoked Rings. (L. H. Donnell and others, J. App. Mech., Vol. 8, No. 2, June, 1941, pp. 67-73.) (92/44 U.S.A.)

The paper briefly discusses the difficulties in usual methods of studying structures with large numbers of redundancies and discusses simplifications which can be made in these methods when the structures are symmetrical. The remainder of the paper discusses the application of trigonometric series to stiffened-ring problems. General solutions are derived by using differential equations of equilibrium for the case of circular rings with continuous radial support, and by using difference equations of equilibrium for the case of polygonal rings with spokes and loads at the corners. Shear and axial strains in the ring and the difference in length of inner and outer fibres of the ring are considered. Finally, the paper shows how complete solutions can be obtained by similar methods for the case of spoked and trussed rings under loads at the joints.

Equiareal Pattern of Stress Trajectories in Plane Plastic Strain. (M. A. Sadowsky, J. App. Mech., Vol. 8, No. 2, June, 1941, pp. 74-76.) (92/45 U.S.A.)

In theoretical plasticity, all work so far done has made use of slip lines as a frame of reference. In the present paper, stress trajectories are used instead, and results of theoretical interest and practical applicability are obtained. The equiareal property of stress trajectories as derived in the present paper can be readily used to evaluate photographs of slip lines in plasticity with a higher degree of accuracy and reliability than hitherto. The analytical method can be applied to the equiareal pattern formed by stress trajectories, and formulas for stresses are obtained. An example referring to radial flow, adequately illustrates the general equiareal property.

https://doi.org/10.1017/S0368393100140179 Published online by Cambridge University Press

On the Internal Resistance of Solid Bodies. (S. Higuchi, J. of Frank. Inst., Vol. 231, No. 5, May, 1941, pp. 421-445.) (92/46 U.S.A.)

Using new types of cantilever test-pieces made of seven different metals and taking the necessary precautions, the natural oscillations of these metals are carefully examined. Based on the results of these experiments, the law of the internal resistance of solids is studied.

It is concluded that the law of viscous resistance applies in the small stress region.

Surface Hardening by Induction. (Osborn, Engineer, 6/6/41, pp. 372-373.) (92/47 Great Britain.)

It is claimed that phenomenal advances have been made in the application of high frequency current to the localised surface hardening of metals. Among the advantages claimed for the process are absence of distortion and scale formation, exact repetition of conditions and an inherent increase in quality coupled with a decrease in cost. The questions of carbide diffusion and super-hardening are investigated and a brief description is given of the equipment employed in the various operations.

(Abstract supplied by Research Dept., Met. Vickers.)

An Inside Look at Welds. (Baldwin, Machinist, 7/6/41, pp. 149-152.) (92/48 Great Britain.)

Particulars are given of the technique employed by the General Electric Company of Schenectady for the examination of welds by X-rays. The use of stereoscopic location of flaws is explained and details given of the procedure and apparatus employed. A special technique has been developed for the G.E. welding school where test plates are X-rayed in groups to keep cost at a minimum.

(Abstract supplied by Research Dept., Met. Vickers.)

A New Process for Shaping Tubing to any Desired Contour. (Machinery, 12/6/41, pp. 287-290.) (92/49 Great Britain.)

Particulars are given of a new process for forming tubing to almost any regular or irregular outline, including straight tapered and rounded portions. The process is stated to be applicable to welded and seamless steel tubes up to 4 in. outside diameter and $\frac{3}{16}$ in. wall thickness in addition to non-ferrous materials. Larger tubing could be handled by a machine of greater capacity or by hot working. Tolerances of plus or minus 0.010 in. with respect both to tube diameter and wall thickness are claimed to be attainable.

(Abstract supplied by Research Dept., Met. Vickers.)

The Buckling of Thin Cylindrical Shells under Axial Compression. (T. von Kármán and H. S. Tsien, J. Aeron. Sci., Vol. 8, No. 8, June, 1941, pp. 303-312.) (92/52 U.S.A.)

In two previous papers the authors have discussed in detail the inadequacy of the classical theory of thin shells in explaining the buckling phenomenon of cylindrical and spherical shells. It was shown that not only is the calculated buckling load three to five times higher than that found by experiments, but the observed wave pattern of the buckled shell is also different from that predicted.

By a theoretical investigation on spherical shells the authors were led to the belief that in general the buckling phenomenon of curved shells can only be explained by means of a non-linear large deflection theory. This point of view was substantiated by model experiments on slender columns with non-linear elastic support. The non-linear characteristics of such structures cause the load necessary to keep the shell in equilibrium to drop very rapidly with increase in wave amplitude once the structure started to buckle. Furthermore, as it was shown in one of the previous papers, the buckling load itself can be materially reduced by slight imperfections in the test specimen and vibrations during the testing process.

In this paper, the same ideas are applied to the case of a thin uniform cylindrical shell under axial compression. First it is shown by an approximate calculation that again the load sustained by the shell drops with increasing deflection. The results of this calculation are used for a more detailed discussion of the buckling process as observed in an actual testing machine.

Rubber Road Springs. (Macbeth, Auto. Engr., June, 1941, pp. 195-199.) (92/50 Great Britain.)

The development of rubber springing is first outlined and points that have influenced rubber technologists are set out in detail. The question of the form of stress most likely to furnish best results in a vehicle suspension is discussed together with various methods of holding or attaching the rubber to its component parts or housing. A scheme is outlined based on the use of a conical torsion disc and the tests and testing rig are described.

(Abstract supplied by Research Dept., Met. Vickers.)

Re-Crystallisation Theory on an Atomistic Basis. (V. Dehlinger, Z.f. Metallkunde, Vol. 33, No. 1, Jan., 1941, pp. 16-20.) (92/53 Germany.)

Any cold working of a crystalline material leads to profound changes in structure. Under certain conditions these changes may subsequently disappear as a result of a kinetic process termed "re-crystallisation." An atomiatic theory of this process must attempt to describe the motion of the atoms during this period of recovery and this entails some knowledge of the atomic structure of the deformed material. Studies with single crystals have shown that a cold worked multi-crystalline material experiences two kinds of lattice distortion characterised by very different degrees of stability.

1. Displacement of the lattice, which can be relieved by a jump of individual atoms, producing the well known phenomenon of recuperation.
2. A distortion of complete lattice sections which can only be eliminated by reactions of a higher order *i.e.*, the formation of re-crystallisation of nuclei.

These nuclei are practically free from distortion energy and their subsequent growth is very similar to that occurring in normal solidification of the molten material.

Scratch Hardness in C.G.S. Units. (W. Ehrenberg, Z.f. Metallkunde, Vol. 33, No. 1, Jan., 1941, pp. 22-23.)

Quantitative Relationship between Scratch and Pressure Hardness. (do., p. 23.) (92/54 Germany.)

The surface of a material can be damaged in two distinct ways:—

1. The constituent particles are displaced, an indentation being formed.
2. Particles are torn away, *i.e.*, the surface is scratched.

The measurement of indentation resistance has become standardised and is expressed as load/area of impression (Brinell hardness, etc.). It is easily determined and in many cases allows useful conclusion to be drawn concerning other mechanical characteristics of the material (ultimate tensile and fatigue limits) requiring much more elaborate apparatus for their direct evaluation.

Such qualities as resistance to wear or machinability of the surface, however, cannot be expressed in terms of pressure or indentation hardness, since now the material is no longer deformed but actually torn away. It is clear that in this case a determination of the resistance to scratching (so-called scratch hardness) would be very useful. Whilst several simple methods of recording scratch hardness are available, they have suffered from the fact that the scales adopted so far have been arbitrary and not expressible in C.g.S. units.

The author proposes a definition of scratch hardness in terms of load per unit area of slip surface.

If γ = vertex angle of cone producing scratch.
b = width of scratch (mm.).
G = load in Kg.

$$\text{Scratch hardness} = \frac{8G \sin(\gamma/2)}{b^2\pi} \text{ Kg./mm.}^2.$$

The pressure hardness obtained with the same cone is defined as :—

$$= \frac{4G \sin(\gamma/2)}{d^2\pi} \text{ Kg./mm.}^2.$$

where d = diameter of circular indentation obtained after a load period of 30 seconds.

The author has carried out a most interesting set of experiments on the variation of scratch and pressure hardness with G for a number of materials. The load range varied from 5 gm. to 10 Kg. A polycrystalline material is practically homogeneous towards deep scratches, and under these conditions the two hardness numbers approximate. If, however, the depth of scratch approaches the dimensions of the constituent grains, marked differences appear, the scratch hardness becoming a minimum whilst the pressure hardness is a maximum. If the scratch is smaller than the average grain size, the pressure hardness falls rapidly whilst the scratch hardness increases.

By means of these relatively simple experiments considerable light is thus thrown on the structure of the material.

Surface Cracks of Cladded Al-Cu-Mg Alloys Undergoing Reversed Bending. (H. Burnheim and R. Mechel, Z.f. Metallkunde, Vol. 33, No. 1, Jan., 1941, pp. 25-27.) (92/55 Germany.)

Samples of high grade cladded Al-Cu-Mg sheets undergoing reversed bending showed a considerable roughening of the surface due to formation of surface cracks in the protecting layer long before the ultimate failure of the core. These cracks are due to differences in the yield point and fatigue limits of protecting surface sheet and core. If the reversed bending stress is of the order of the yield point of the core (*i.e.*, failure after a few thousand cycles) surface roughening becomes apparent almost immediately. For lower bending stresses corresponding to an endurance of 10^7 cycles, the surface cracks take longer to develop and are fewer in number. On the other hand the cracks are now much deeper, some of them projecting right into the core. It is clear that such cracks may effect the fatigue strength of the core (notch sensitivity). In any case they will reduce the corrosion resistance of the combination.

The Influence of Impurities on the Corrosion Resistance of Mg and its Alloys with Mn and Al. (A. Beerwald, Z.f. Metallkunde, Vol. 33, No. 1, Jan., 1941, pp. 28-31.) (92/56 Germany.)

After obtaining Mg of a very high degree of purity by means of distillation in vacuum, the author investigated the effect of small additions of Fe and Cl on the corrosion resistances of Mg and Mg-Mn-Al alloys (attack by 0.3 per cent. salt solution). The so-called eudiometer method was employed in which the quantity of H_2 liberated is measured over a time basis.

The results show that the presence of small quantities of iron is most active in promoting the corrosion of Mg and Mg-Al alloys. The presence of as little as 0.005 per cent. Fe trebles the corrosion rate compared with that of pure Mg, the effect reaching a maximum at 0.02 per cent. Fe. Similar results apply to Mg-Al alloys.

On the other hand, the presence of iron does not affect the high corrosion resistance of Mg-Mn alloys.

Chlorine, unless present in the form of slag inclusions, appears to have no effect on the corrosion resistance.

The Mechanical Properties of Solids. (E. N. da Costa Andrade, J. Inst. Civil Engineers, Vol. 16, No. 7, June, 1941, pp. 287-308.) (92/57 Great Britain.)

The mechanical properties of solids depend largely on the previous history of the sample. This even applies to single crystals. Such crystals are quite soft when first made, and a crystal rod of copper ½ in. diameter can be easily bent by hand. To straighten the rod after bending is, however, much more difficult, due to strain hardening of the material. This hardening is due to the irreversible nature of the slip phenomena which are fully discussed by the author. It appears that the tensile strength of most engineering materials is considerably below theoretical values. The author attributes this to surface imperfections leading to considerable stress concentrations. Such imperfections are more likely to persist in metallic crystalline conglomerates, and it may be possible to develop alternative non-crystalline materials of vastly improved strength characteristics.

The Steady Flow of Heat from Certain Objects Buried Under Flat Air-Cooled Surfaces. (F. H. Schofield, Phil. Mag., Vol. 31, No. 209, June, 1941, pp. 471-497.) (92/58 Great Britain.)

A general method of estimating the steady flow of heat from, and the temperature distribution around, objects buried under flat air-cooled surfaces is developed for a considerable class of two-dimensional problems. By this method, an approximate solution of the problem is at once derived from the simpler solution of the corresponding problem in which the sink of heat, instead of being, as required, a surface subject to Newton's law of cooling, is an isothermal surface.

A critical examination of the method is made, with satisfactory results, in three practical cases, viz.:—

1. A pipe or cable buried in the ground.
2. The same in a wall.
3. A girder or ship's rib projecting into a wall.

The Propagation of Sound in the Free Atmosphere and its Dependence on Meteorological Conditions. (H. Sieg. El. Nachrichten, Technik, Vol. 17, No. 9, Sept., 1940, pp. 193-208.) (92/59 Germany.)

Wind is by far the most important meteorological factor influencing the propagation of sound. Pure temperature effects only become marked in practically calm weather. In the latter case, the minimum reduction in sound intensity with distance is of the order of 1 db./100 m. for the frequency range 250-4,000 vibration/sec. A clouded sky, fog and drizzle favour the carrying power of the sound. Atmospheric turbulence is detrimental.

Due to molecular absorption, high frequency notes are absorbed more readily than sounds of lower pitch, and this becomes more marked the higher the frequency.

The propagation is also influenced by the height of the source above ground. If the transmitter is in close proximity to the ground, the propagation of high frequency notes is favoured.

Requirements of a Smoke Meter. (K. M. Brown, S.A.E. Journal, Vol. 48, No. 5, May, 1941, pp. 188-192.) (92/61 U.S.A.)

The necessity of being able to evaluate the degree of smoke in the Diesel engine exhaust is becoming universally recognised. Various methods of measuring smoke are discussed briefly.

Of these methods, the light-absorption, photo-electric cell, sampling-type smoke meter appears to the the most satisfactory.

Design requirements are listed, and a smoke meter is described which appears to meet them with reasonable satisfaction. The principal departures in the design of this smoke meter from that of others of the same type are in the greater length of the measuring tube, the use of a flashlamp type bulb with reflector for a light source, and the use of a vacuum pump to draw the sample through the smoke meter.

The term " smoke density per unit of smoke column " is proposed as the basis of a standard scale.

Temperature Distribution in Light Alloy Billets during Heating and Cooling. (W. Roth, Z.f. Metallkunde, Vol. 33, No. 1, Jan., 1941, pp. 13-15.) (92/60 Germany.)

The author investigates mathematically the following problems:—

(1) An infinitely long bar at room temperature is suddenly exposed to a gas temperature of 500°C. How does temperature at centre of bar vary with time (air quiescent)?

(2) The infinitely long bar at 500°C. throughout is suddenly exposed to cold air at room temperature—variation of temperature at centre with time (air quiescent).

(3) Temperature difference between centre and surface of bar both during heating and cooling as above, as a function of temperature at centre.

(4) Surface temperature of bar originally at room temperature throughout is suddenly raised to 500°C. and kept at that value. Variation of temperature at centre with time.

(5) Surface temperature of bar originally at 500°C. throughout is suddenly reduced to 100°C. and kept at that value. Variation of temperature at centre with time.

The calculations show that under conditions (1) and (2) (quiescent air) the maximum temperature difference between centre and surface of bar is less than 10°C. for a bar diameter of 400 mm. and about 2.5°C. for a bar diameter of 100 mm. Sudden immersion in a salt bath (at 500°C.) or sudden quenching in water (100°C.) naturally produces large temperature differences between centre and core in the first instance. These differences disappear, however, in a few minutes, and even in the most unfavourable case (diameter 400 mm.) core and surface are at practically the same temperature after ten minutes.

A New High Speed Indicator System (Digest). (E. E. Simmons, S.A.E. Journal, Vol. 48, No. 5, pp. 23-24.) (92/62 U.S.A.)

Extending the use of the bonded resistance gauge to fluid pressure measurement provides several important advantages over present apparatus, especially for high speed and high pressure applications. In one arrangement, a piston or diaphragm actuates a dynamometer bar upon which is attached a strain-sensitive winding. An element of this type may be assembled in a threaded plug for easy attachment to a combustion or pressure chamber. Pressure plugs of good dynamic accuracy capable of static calibration are feasible for pressures as high as those existing in gun chambers.

A second arrangement utilises the radial expansion of a tubular structure under pressure to actuate a bonded strain winding. A closed-end tube fitted into a threaded plug provides a useful indicator pressure element. Through type tubular gauges furnish a simple method of observing pressures existing during fluid flow, as in Diesel injection or rifle operation. Such gauges can be constructed to cover the full range of pressure measurement.

Experience with Flow Direction Instruments. (B. Eckert, Jahrbuch D.L.F.F., 1938, Vol. 2, pp. 381-386.) (R.T.P. Translation T.M. 969.) (92/63 Germany.)

Instrument for measuring flow direction may be of the direct or indirect type. The former method is generally only applicable in specially very extensive flows, the flow direction being given by the angle of yaw of the recorder with respect to some fixed plane of reference. Instruments of the indirect type are provided with a number of orifices placed at certain angles and the direction of flow is obtained from the pressure record, making use of a calibration curve. Such instruments have the advantage of only requiring very little space.

The principal instruments described in the article are listed below:—

(*a*) *Two-dimensional flow*—
- Prandtl pitot.
- Sers plate.
- Double pitot.
- Cylindrical tube with openings.

(*b*) *Three-dimensional flow*—
- Dynamic pressure claw with three pitots.
- Dynamic pressure claw with five pitots.
- Spherical pitot.
- Spherical pitot with transverse flow effects.

The author concludes that the method of recording flow direction on the basis of the hydrodynamic zero point measurement has now reached a certain limit as to possible accuracy. The next problem will be to achieve a point by point flow direction record of greater accuracy with simplified test procedure.

Elastic Mounting of Quartz Crystal to Eliminate Inertia Effects in Piezo Electric Pressure Indicators. (J Kluge and others, 2 fur Instrumenten Kunde, Vol. 61, No. 2, Feb., 1941, pp. 65-66.) (92/64 Germany.)

In the normal piezo electric indicator, the quartz crystal abuts against a rigid wall and the electric charge generated is thus affected by the inertia of the crystal. This leads to errors in the pressure record and, moreover, may cause the crystal to crack. To obviate these difficulties, the authors mount the quartz between two diaphragms of equal stiffness so that the crystal is subjected to a preliminary compression. Inertia forces due to the crystal itself will cause a reduction of contact pressure on one side and a corresponding increase on the other, *i.e.*, the resultant electric charge is zero. Whilst this mounting thus automatically compensates for inertia effects, the sensitivity of the instrument is reduced, since a portion of the pressure is now absorbed by the diaphragms.

The same principle can also be applied to piezo electric indicators of the piston type.

If M_d = mass of piston assembly.
M_Q = mass of quartz crystal.
C_1 = stiffness of front diaphragm.
C_2 = stiffness of rear diaphragm.

Inertia compensation is effected if

$$\frac{C_1}{C_2}=\frac{(2\,M_d+M_Q)}{M_Q}$$

It is stated that an instrument designed on these lines proved highly successful.

Mercury Vapour Lamps for Electric Flashlight Stroboscopes. (P. Drewell, Z.f. Instrumentenkunde, Vol. 61, No. 3, March, 1941, pp. 99-100.) (92/65 Germany.)

For stroboscopic purposes, the ordinary Neon lamp suffers from the drawback of very low light intensity. The author describes an electric circuit for the starting and quenching of a high pressure mercury vapour lamp (six atmospheres). The duration of the flash is of the order of 2×10^{-5} sec., its intensity 800,000 Heffner candles. It is stated that the discharge current of the lamp is of the order of 3,000 amp.

A Flashlight Time Interval Recorder Suitable for Short and Medium Intervals. (K. Botz, Z.f. Instrumentenkunde, Vol. 61, No. 4, April, 1941, pp. 135-136.) (92/66 Germany.)

The device is intended mainly for ballistic research, the projectile passing through two wire coils placed at a suitable distance apart. The passage through the first coil generates a current impulse which discharges a high tension condenser, the resultant spark illuminating a rotating scale. A second spark is generated by passage through the second coil. Both scale images are photographed on the same film, the optical arrangement being such that the two portions of the scale appear immediately above one another. The drum carrying the scale rotates at 100 rev./sec., this speed being controlled stroboscopically to an accuracy of 0.01 per cent. The time interval between the two sparks is measured by the difference between any two vertical scale readings and is thus unaffected by distortion of the film during development. As there are 100 graduations, a displacement of one scale division corresponds to 10^{-4} sec. By reading 1/10 divisions, time intervals of the order of 10^{-5} seconds are recorded. By means of a special switch, both sparks can be released in series and the electrical time lag (of the order of 0.5×10^{-6} sec.) determined directly.

In order to measure longer time intervals (of the order of 1 sec.) a second scale rotating at 1 rev./sec. is incorporated, the photographs of the two scales being superposed as before.

Note on the Paper: "A New Determination of the Viscosity of Air by the Rotating Cylinder Method." (G. Kellstrom, Phil. Mag., Vol. 31, No. 209, June, 1941, 466-470.) (92/67 U.S.A.)

Attention has been drawn to two corrections to the simple theory of the rotating cylinder method, which have not been considered in earlier determinations of η by this method—the end-correction to the length of the inner cylinder and the correction for the influence of the air on the effective moment of inertia of the inner cylinder. In the present paper the influence of these corrections on the writer's earlier η value is calculated.

As the two corrections act in different directions, the resulting correction is very small. Owing to the uncertainty in the calculation, however, the limit of error ought to be raised a little, and the final result may therefore be written:—

$$\eta_{20^\circ} = (18{,}204 \pm 30)\ 0.10^{-8},$$
$$\eta_{23^\circ} = (18{,}352 \pm 30)\ 0.10^{-8}.$$

Administrative Report of the N.A.C.A. for the Fiscal Year ending June 30th, 1940. (92/68 U.S.A.)

The total amount allocated for general purpose amounted to 2.02 million dollars, of which 1.39 million dollars were spent on personal services. The expenditure on printing comes out of a separate fund (23,000 dollars).

In addition to the above, 2.22 million dollars were spent during the year under review on improvements and new equipment at Langley Field Laboratory, whilst a further 2.6 million dollars went towards the equipment of the new Ames Laboratory at Moffat Field, California, the flight research department of which is now in operation.

The work of the following committees is briefly reviewed:—

Main Committees.

Aerodynamics.

Power plant for aircraft.

Aircraft materials.
Aircraft structure.

Sub-Committees.
Meteorological problems.
Seaplanes.
Vibration and flutter.
Fuel and lubricants.
Supercharger compressors.
Exhaust gas turbines and inter-coolers.
Miscellaneous material and accessories.

In order to ensure close contact with other research activities in the U.S.A. a special co-ordination office has been set up and arrangements have been made for the research personnel to be in close touch with manufacturers. During the year under review, three technical reports and thirty-three technical notes of outstanding interest were released for publication. In addition forty-three translations from the foreign technical and scientific press were issued.

At the request of the United States Army and Navy, both Reports and Notices were placed on the restricted status on June 1st, 1940, and subsequent numbers are not available for general distribution.

The following paragraph is taken from the concluding remarks of the Chairman:—

"It is the responsibility of the N.A.C.A. to anticipate the research needs of aviation and the progress that can be made and to furnish the Army, the Navy, and the industry in the United States with a constant flow of the new knowledge that is essential to American leadership in aircraft performance."

Characteristics of Fire Jets. (J. S. Blair, J. Inst. Civil Engineers, Vol. 16, No. 7, June, 1941, pp. 354-380.) (92/69 Great Britain.)

In view of the scanty information available, the author carried out a series of tests dealing with the heights and throws of water jets at all angles and in particular the throws obtainable with limited rise of jet trajectory above the nozzle was investigated. This is of importance when fighting fires in constricted passages.

The programme of tests covered the following points:—

(1) Nozzle efficiency and relationship between discharge and pressure.
(2) Loss of pressure in fire hose.
(3) Relationship between height of jet, angle of projection and pressure.
(4) Relationship between throw of jet, angle and pressure.

The results are given in a series of tables covering the following standard sizes of nozzle $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, $\frac{7}{8}$ and 1 in.

LIST OF SELECTED TRANSLATIONS.

No. 35.

NOTE.—Applications for the loan of copies of translations mentioned below should be addressed to the Secretary (R.T.P.3), Ministry of Aircraft Production, and not to the Royal Aeronautical Society. Copies will be loaned as far as availability of stocks permits. Suggestions concerning new translations will be considered in relation to general interest and facilities available.

Lists of selected translations have appeared in this publication since September, 1938.

Aero- and Hydrodynamics.

Translation Number and Author.		Title and Reference.
1198	Poggi, L. ...	... *The Velocity Field in a Two-Dimensional Flow of Compressible Fluid.* (L'Aerotecnica, Vol. 12, No. 12, Dec., 1932, pp. 1,579-1,593.)
1199	Eck, B. ...	... *Theory and Design of Propeller Fans (Axial Blowers).* (Ventilatoren, 1937, Section B, pp. 137-169, Section C, 178-185.)

Aircraft and Accessories.

1203	Hartwig, G.	... *The Break-away of the Wing Flow as affected by Flaps and Wing Fittings (Engine Nacelles and Fuselage).* (L.F.F., Vol. 18, No. 2-3, 29/3/41, pp. 40-46.)
1207	Krumbholz, H.	... *Some Notes on the Frequency of Gust Loads on Wings.* (L.F.F., Vol. 18, No. 2-3, 29/3/41, pp. 82-85.)
1212	Toulyakov, V. P. ...	*Experimental Research on Undercarriage Loads and the Efficiency of Shock Absorbers.* (Aeron. Eng., U.S.S.R., Vol. 15, No. 1, Jan. 1941, pp. 44-52.)

Engines and Accessories.

1204	Brode, K. ...	... *Three New Engines of the B.M.W. 132 Series.* (Luftwissen, Vol. 8, No. 2, Feb., 1941, pp. 57-59.)
1208	List, H. ...	... *Flow Phenomena in the Induction Pipes of Internal Combustion Engines.* (Z.V.D.I., Vol. 85, No. 13, 29/3/41, pp. 301-305.)
1209	Hoff, W. ...	... *Non-Dimensional Expressions for the Performance of the Airscrew Engine Combination.* (L.F.F., Vol. 17, No. 10, 26/10/41, pp. 299-305.)
1215	Sabel, R. ...	... *General Problems Connected with the Cooling of Engines during High Altitude Flight.* (Jahrbuch der deutschen Luftfahrtforschung, 1938, Vol. 2, pp. 257-270.)

Materials and Elasticity.

1206	Karas, F. ...	... *Fatigue Strength of Bearing Surfaces Against Pitting.* (Z.V.D.I., Vol. 85, No. 14, 15/4/41, pp. 341-343.)
1210	Rossow, E. ...	... *Materials for Aero Engine Gears.* (Luftwissen, Vol. 8, No. 3, March, 1941, pp. 86-90.)
1214	Hemel, M. ...	... *Fatigue Characteristics of Ordinary Malleable Cast Iron.* (Z.V.D.I., Vol. 85, No. 12, 22/5/41, pp. 290-292.)

TITLES AND REFERENCES OF ARTICLES AND PAPERS SELECTED FROM PUBLICATIONS RECEIVED IN R.T.P.3 DURING JUNE, 1941, TOGETHER WITH LIST OF NEW TRANSLATIONS RENDERED AVAILABLE.

Notices and abstracts from the Scientific and Technical Press are prepared primarily for the information of the Scientific and Technical Staffs. Particular attention is paid to the work carried out in foreign countries, on the assumption that the more accessible British work (for example that published by the Aeronautical Research Committee) is already known to these Staffs.

THEORY AND PRACTICE OF WARFARE.

77/1	Great Britain	*North American NA-40 Bomber (Photograph).* (Aeroplane, Vol. 60, No. 1,563, May 9, 1941, p. 512.)
77/2	Great Britain	*Douglas B-19 Nearing Completion (Photograph).* (Aeroplane, Vol. 60, No. 1,563, 9/5/41, p. 512.)
77/3	Great Britain	*New Italian Bombers (Fiat R.S. 14 Seaplane and Cant Z1008 Landplane, Breda 210 (=Ju. 87B) Dive Bomber).* (Aeroplane, Vol. 60, No. 1,563, 9/5/41, p. 513.)
77/4	Great Britain	*Me. 109 Bomb Attachment (Photograph).* (Aeroplane, Vol. 60, No. 1,563, 9/5/41, p. 520.)
77/5	Great Britain	*Focke Wulf F.W. 189 Army Co-operation.* (Aeroplane, Vol. 60, No. 1,563, 9/5/41, p. 524.)
77/6	Great Britain	*Curtiss (XSB2C-1) Dive Bomber.* (Flight, Vol. 39, No. 1,689, 8/5/41, pp. 333-334.)
77/7	Great Britain	*Hawker Typhoon.* (Aeroplane, Vol. 60, No. 1,562, 2/5/41, p. 485.)
77/8	Great Britain	*Fiat Cr 32 Bis Single-Seat Fighter.* (Aeroplane, Vol. 60, No. 1,562, 2/5/41, p. 494.)
77/9	Great Britain	*The Birth of the Typhoon.* (C. M. Poulsen, Flight, Vol. 39, No. 1,689, 8/5/41, p. 328 F and H.)
77/10	Germany ...	*New Solution of the First Main Problem of External Ballistics.* (K. Eggens Wiss, Abh. Reichsamt f. Wetterdienst, Vol. 5, No. 11, 1939, pp. 11-16.) (Zent B, Vol. 10, No. 4, 11/11/40.)
77/11	Germany ...	*Anti-Aircraft Ballistics.* (I. Sintes, Compt. Rend. Acad. Sci. Roum., Vol. 3, 1939, pp. 263-268, 9-558, 683-690.) (Zent B, Vol. 10, No. 4, 11/11/40.)
77/12	Germany ...	*Mathematical Calculation of the Impact Force of Bombs.* (F. Frey, Schweiz Techn. Zeit, No. 24, 1940, pp. 293-294.) (Zent B, Vol. 10, No. 4, 11/11/40.)
77/13	Great Britain	*Features of the Liberator (Production Process of Consolidated B-24 Four-Engined Bomber).* (Airc. Prod., Vol. 3, No. 31, May, 1941, pp. 156-160.)
77/14	U.S.A. ...	*Curtiss XSB2C-1 Dive Bomber.* (American Aviation, Vol. 4, No. 21, 1/5/41, p. 6.)
77/15	U.S.A. ...	*Production Figures for American Aircraft Engines.* (American Aviation, Vol. 4, No. 21, 1/5/41, p. 38.)

77/16 U.S.A. ... *Northrop Five-ton Patrol Bomber.* (American Aviation, Vol. 4, No. 21, 1/5/41, p. 43.)

77/17 U.S.S.R. ... *The Tactics of Aviation in the Present War.* (V. V. Marrin, Air Fleet News, Vol. 23, No. 3, March, 1941, pp. 201-207.)

77/18 U.S.S.R. ... *Air Defence Against Troop Landings (by the Navy).* (D. U. Marchurow, Air Fleet News, Vol. 23, No. 3, March, 1941, pp. 213-215.)

77/19 U.S.S.R. ... *Calculation of the Ballistic Elements for Firing in the Air (contd. from No. 2).* (V. S. Pugachev and B. K. Blinov, Air Fleet News, Vol. 23, No. 3, March, 1941, pp. 217-228.)

77/20 U.S.S.R. ... *The Use of Armour in Aircraft.* (N. I. Shaurov, Air Fleet News, Vol. 23, No. 3, March, 1941, pp. 243-247.)

77/21 Great Britain *Boeing B. 17C Flying Fortress (Photograph).* (Flight, Vol. 39, No. 1,690, 15/5/41, p. 340.)

77/22 Great Britain *Lockheed "Lightning" Twin-Engined Single-Seater Fighter.* (Flight, Vol. 38, No. 1,690, 15/5/41, p. 341.)

77/23 Great Britain *Focke-Wulf 189 Reconnaissance Fighter.* (Flight, Vol. 39, No. 1,690, 15/5/41, p. 341.)

77/24 Great Britain *The American Fighter (Comparison with British Types).* (J. I. Waddington, Flight, Vol. 39, No. 1,690, 15/5/41, p. 344.)

77/25 Great Britain *Republic "Thunderbolt" Fighter.* (Aeroplane, Vol. 60, No. 1,564, 16/5/41, p. 539.)

77/26 Great Britain *Douglas "Boston" and "Havoc" Twin-Engined Bomber.* (Aeroplane, Vol. 60, No. 1,564, 16/5/41, p. 538.)

77/27 Great Britain *Mass Production of Ju. 88.* (Aeroplane, Vol. 60, No. 1,564, 16/5/41, p. 545.)

77/28 Great Britain *Boeing Flying Fortress.* (Aeroplane, Vol. 60, No. 1,564, 16/5/41, p. 546.)

77/29 Great Britain *Curtiss 81A Tomahawk.* (Aeroplane, Vol. 60, No. 1,564, 16/5/41, p. 548.)

77/30 Great Britain *American Aviation To-day as a Decisive Factor in World Affairs.* (J. Franklin Inst., Vol. 231, No. 3, March, 1941, pp. 203-221.)

77/31 Great Britain *Standardisation in War Time.* (Engineering, Vol. 151, No. 3,928, 25/5/41, p. 331-332.)

77/32 Germany ... *Dive Bombing.* (H. Wenke, Luftwissen, Vol. 8, No. 4, April, 1941, p. 115-117.)

77/33 Germany ... *Rescue Pontoon for Aircraft Crews Forced Down on the Water.* (Luftwissen, Vol. 8, No. 4, April, 1941, p. 128.)

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