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Sights Employed in Anti-Aircraft Gunnery. (A. Kuhlenkamp, Z.V.D.I., Vol. 81, No. 51, 18/12/37, pp. 1453-7. Eng. Absts., Vol. 1, No. 1, January, 1938, p. 12. Available as Translation No. 600.) (54/1 Germany.)

The author discusses the problem of anti-aircraft sighting, more especially as applied to the use of machine guns and automatic guns up to 0.8in. bore. For the small calibre machine gun the ring sight with its modified elliptical form is most suitable. The theory of the circular and elliptical ring sight is given. For larger weapons with greater range the ring sight is inadequate. The author discusses the three typical French (Le Prieur-Ricordel), German, and Italian (Breda) telescopic bar sights used for medium calibre guns. The main geometry of the problem is outlined in terms of the standard target triangle with apexes at the gun, at the target when sighted and at the target when hit, and the effects of quadrant elevation are qualitatively shown to be as the cosine of the elevation. With regard to larger anti-aircraft guns—2in. and upwards—the author observes that in most armies gun control by predictor methods without sights is used, but that in the smaller countries the usual practice is to use a telescopic sight of high magnifying power and to give verbal orders to the gunlayer from a separate calculating and spotting squad. In the German design illustrated a reflex collimator arrangement is employed, by means of which the eye of the layer is relieved considerably; the " sights " in effect are replaced by an illuminated cross wire or graticule focused at infinity, and this is brought into coincidence with the target.

Forecasts from the War in Spain. (E. Canevari, Army Ordnance, Vol. 18, No. 107, March/April, 1938, pp. 273-280. From the Italian.) (54/2 Italy.)

The following main conclusions are drawn :—

(1) The Spanish war has confirmed the fundamental importance of a sound, well trained infantry, equipped with powerful weapons. The German " Schmeisser " sub-machine gun is an improvement on the standard rifle. An ample supply of hand grenades is essential.

(2) Tanks, whether light or heavy, have failed to produce any useful results.

(3) Heavy artillery can only follow up an attack, if the supply of munition is assured by extensive mechanisation. Co-operation between artillery and infantry is indispensable, but at the same time becoming increasingly difficult to achieve.

(4) Great care is necessary in drawing general conclusions from the use of aircraft in the civil war (small number of aircraft employed, multiplicity of types, lack of trained pilots, lack of bases).

It appears, however, that

(*a*) Modern high speed bombers can generally reach their objective in spite of fighter attack.

(*b*) " Attack " aviation (co-operation with land forces) is very effective and is certain to play a most important *rôle* in any future war.

(*c*) Aerial predominance is more a question of quality (material plus pilot) than quantity.

(*d*) German anti-aircraft artillery has proved very effective.

The Air Force on Trial—Lessons of Abyssinia, Spain and China. (Laurent-Eynac, L'Air, No. 440, 1/3/38, p. 141.) (54/3 France.)

Abyssinia.—It was the Air Force which made the Italian conquest possible in a very short time. Due to the absence of enemy aircraft, the Italians were able to reconnoitre large distances and prepare the way for the advance of land troops. The supply of food and ammunition by aircraft to the troops first practised on a large scale in this campaign, marks a new era in colonial warfare.

Spain.—The outstanding feature is the active co-operation of aircraft during the actual land battle. The bombardment of aerodromes is a most effective method of impeding the enemy. Anti-aircraft guns are effective up to 4,000 m. and make artillery observation by aircraft increasingly difficult.

Finally, speed is the most important factor and slow obsolete aircraft are useless.

China.—The bad strategic position of Chinese aerodromes facilitated their destruction by the Japaneses, who are in complete command of the air. Large scale bombing attacks on towns are effective in terrorising both the civilian and military occupants. Accurate bombing aim apparently only possible in dive bombing.

Sound Ranging of Aircraft with Optical Recording. (French Patent No. 803,586.) (Skoda Work, Rev. de l'Arm. de l'Air, No. 102, January, 1938, pp. 109-111.) (54/4 Czechoslovakia.)

In normal sound ranging, the observer rotates a frame carrying two parallel receivers till the sound reaches both at the same time. The adjustment is thus entirely subjective. In the present patent, the adjustment is carried out optically and it is claimed that highly trained observers are not required. Each microphone circuit feeds a neon lamp through a suitable amplifying circuit, the sensitivity being such that the lamp only lights up at the peak pressure values of the sound to which the receiver is tuned. The light is reflected on to a screen by a rotating mirror, the resultant fringe system being a measure of the sound frequency. The second microphone produces an equivalent fringe system which is generally displaced relatively to the first. The frame is rotated till the two systems overlap. Under these conditions there is equality of phase and the source must therefore be on a line bisecting the receiver frame and situated on a plane containing the acoustic axes of the receivers.

Aerial Warfare in Spain from the Republican Point of View. (C. Sweeny, L'Aerophile, Vol. 46, No. 3, March, 1938, pp. 55-57.) (54/5 France.)

The author accompanied the French General Armengaud on a visit during November and December, 1937.

The following remarks on Franco's air force are of interest:—

(1) The Messerschmitt single-seater fighter is too fast to be manœuvrable and can be beaten by the Russian (Boeing) fighter, although the latter is slower.

(2) The Fiat fighters are vulnerable on account of the exposed position of the fuel tank.

(3) The Heinkel, Dornier and Savoia machines are held in great respect.

The Republican machines referred to are given in the following table. They are mainly of Russian origin, although it is stated that the manufacture of similar types in Spain is making good progress.

Name.	Type.	Engine.	Armament.	Duty.	Speed.
Chato	Boeing	1 Hispano	4 machine guns	Fighter	330 km./h.
Natacha	Breguet	1 Whirlwind	2 ,, ,,	Ground attack	200 ,,
Katchousca	Trait-d'Union	1 Whirlwind	5 ,, ,,	High altitude bomber	380 ,,
Mosca	Low wing monoplane	2 Whirlwind	4 ,, ,,	Dive bomber and fighter	440 ,,

The ground attack on troops is carried out at altitude of only 50 m. and under these conditions the defence measures are very inefficient. The ammunition is mixed and consists in succession of tracer, armour piercing, tracer, a piercing, incendiary, explosive and tracer. Opinion is divided whether the incendiary or the explosive bullets produce the greater moral effect on the troops.

The Variation with Reynolds Number of Pressure Distribution Over an Aerofoil Section. (R. M. Pinkerton, N.A.C.A. Report No. 613, 1938.) (54/6 U.S.A.)

Pressures were simultaneously measured at 54 orifices distributed over the mid-span section of a five by thirty-inch rectangular model of the N.A.C.A. 4412 aerofoil in the variable density tunnel. These measurements were made at seventeen angles of attack from $-20°$ to $30°$ for eight values of the effective Reynolds number from approximately 100,000 to 8,200,000. Accurate data were thus obtained for studying the variation of pressure distribution with Reynolds number.

These results on the N.A.C.A. 4412 section indicate that the pressure distribution is practically unaffected by changes in Reynolds number except where separation is involved.

Notes on the Laminar Sub-layer in Smooth Pipes. (R. L. Stoker, J. Aer. Sci., Vol. 5, No. 4, Feb., 1938, pp. 132-3.) (54/7 U.S.A.)

It is generally believed that a laminar sub-layer always exists in the immediate vicinity of all solid boundaries of fluid flow systems. Although the thickness of this layer may be exceedingly small, it nevertheless plays an important *rôle* in the dissipation of mechanical energy by fluid friction, in heat transfer, and in explaining the distinction between hydraulically smooth and rough surfaces.

For any particular flow system, the thickness of the sub-layer would be expected to fluctuate with time and position along the boundaries due to eddies rolling up and leaving the laminar layer. The author attempts to derive an expression for a sort of average thickness with special reference to flow in smooth circular pipes, and to express the rate of energy dissipation within the sub-layer.

A Simple Method for Determining the Aerodynamic Centre of an Aerofoil. (M. J. Thompson, J. Aer. Sci., Vol. 5, No. 4, Feb., 1938, pp. 138-40.) (54/8 U.S.A.)

In presenting experimental data on the aerodynamic characteristics of aerofoils, it is now generally accepted practice to refer the pitching moment coefficients to the aerodynamic centre of the aerofoil section. This point is defined as that about which the moment coefficient is constant throughout the range of angles of attack corresponding to the linear part of the lift curve. The author presents a simple method for locating exactly the aerodynamic centre of an aerofoil directly from wind tunnel test data, all that is required being the lift and drag characteristics and the moment of the air reaction referred to some known point.

An Integrator for Evaluating the Downwash from a Span-Load Curve. (A. Sherman, J. Aer. Sci., Vol. 5, No. 4, Feb., 1938, pp. 148-50.) (54/9 U.S.A.)

The purpose of this paper is to describe a mechanical integrator that derives the downwash distribution directly from a span-loading curve for any particular wing. Such a machine finds its application in checking span-load distributions that may have been either obtained by a Fourier series analysis or assumed in the process of an example of the iteration, or successive approximation, method.

In use, the integrator is set to the spanwise station for which the downwash is desired, a tracing pointer is run over the loading curve from wing tip point to wing tip point, and the value of the downwash is then read directly from the instrument. The distribution of downwash thus obtained, together with the geometry and attitude of the wing and the aerodynamic characteristics of its profiles, produces a new or check loading curve that should agree with the one from which it was derived, providing that that curve be the true span load distribution for the wing.

Problems of High Speed Flight as Affected by Compressibility. (C. N. H. Lock, J.R. Aer. Soc., Vol. 42, No. 327, March, 1938, pp. 193-228.) (54/10 Great Britain.)

Both the lift and drag of an aerofoil undergo considerable changes as the relative speed of flow increases. Depending on the curvature of the body, the local velocity of sound may be reached over certain regions whilst the main flow is still subsonic. As soon as this occurs, the flow pattern changes completely due to the formation of discontinuities (shock waves). The resultant change in pressure distribution accounts for the decrease in lift observed, whilst the entropy loss in the wave together with increased boundary layer loss determine the increase in drag.

In the case of subsonic flow it is easy to calculate the local velocity at any point of a simple contour (ideal incompressible medium), the velocity at infinity being known. Making certain reasonable assumptions the calculations can be extended to include compressibility, *i.e.*, the minimum speed at infinity can be calculated which will correspond to the local velocity of sound at the critical point of the boundary. This minimum speed is called the shock stalling speed and presents a limit to the speed range of orthodox aircraft. It is interesting to note that whilst in pure supersonic flow thin sharp edged aerofoils are required, in the region of mixed flow ordinary streamlined shapes with blunt noses are to be preferred. From a general survey of the problem the author concludes that with ducted engine cooling, aircraft speeds of the order of 500-600 miles should be possible with more or less orthodox designs before the compressibility effect become marked.

(A more extended bibliography containing references to Italian and German work would have been of interest.)

Model Tests on Road and Rail Vehicles, with Special Reference to Testing Under Water. (B. Finzi-Contini, Rendiconti Reale Instituto Lombardo, No. 70, Dec., 1937, pp. 405-28. Eng. Absts., Vol. 1, No. 1, January, 1938, p. 8.) (54/11 Italy.)

The author observes that at high speeds the aerodynamical portion of the resistance becomes predominant and calls for special study in order to enable the best forms of streamlining to be determined. Such study on full-sized vehicles is difficult and model experiments relying on the principle of similarity are generally preferable; but in this case (unlike research on aircraft) it must be remembered that the resistance is affected considerably by the relationship and proximity of the underside of the vehicle to the road surface or rail bed, and according to whether the latter is in a cutting or tunnel, on a raised bank, etc.

The author describes how such experiments may be made using a stationary model in a wind tunnel (*a*) over a fixed base; (*b*) over a moving belt representing the relative motion of the roadway; (*c*) with a second model placed in the position of a looking glass image to the first; but he explains that all these methods—especially (*a*)—are defective. He discusses experimental work on moving models, developing the relevant mathematics and presenting a graph of the aerodynamical resistance to the motion of a cylindrical body expressed as a function of the Reynolds number in the surrounding fluid. From these considerations he deduces the possibility and advantages of making the experiments with models moving along a model track (of any desired cross section) placed under water in a ship-testing tank.

On the Velocity and Temperature Distribution in the Turbulent Wake Behind a Heated Body of Revolution. (S. Tomotika, Proc. Roy. Soc., Series A, Vol. 165, No. 920, 18/3/38, pp. 53-64.) (54/12 Japan.)

In the present paper, Taylor's modified vorticity transport theory of turbulence is applied to the calculation of the velocity and temperature distributions in the turbulent wake behind a solid of revolution which is placed in a uniform stream such that its axis of revolution is parallel to the direction of the undisturbed velocity.

In order to carry out the calculation, it is assumed, with Prandtl, that for sufficiently high Reynolds numbers and at a sufficient distance downstream, there is geometrical and mechanical similarity in different sections of the wake and that the values of the mixing length at corresponding points in different sections are proportional to the breadths of the sections. Also, the isotropy in turbulence is assumed.

Assuming the mixing length to be constant over any one section, the distribution of mean velocity is first calculated and the result is compared with the results of Schlichting's and Simmons's observations. The agreement between theory and observations is not quite satisfactory.

Next, the distribution of temperature is calculated. However, the comparison of the theoretical result with observations is not made, because no measurements of the distribution of temperature in the wake behind a heated body of revolution have yet been made.

Application of the Modified Vorticity Transport Theory to the Turbulent Spreading of a Jet of Air. (S. Tomotika, Proc. Roy. Soc., Series A, Vol. 165, No. 920, 18/3/38, pp. 65-72.) (54/13 Japan.)

The turbulent spreading of a jet of air emerging from a small circular aperture is discussed on the basis of Taylor's modified vorticity transport theory of turbulent motion. Assuming the isotropy in turbulence, the distribution of mean axial velocity is calculated for any one section of the jet whose distance from the aperture is great in comparison with the diameter of the aperture. The calculated curve is compared with the Göttingen measurements and a fairly satisfactory agreement between theory and observations is found (as in the case of Tollmien's calculation on the basis of Prandtl's momentum transport theory).

An Experimental Determination of the Spectrum of Turbulence. (L. F. G. Simmons and C. Salter, Proc. Roy. Soc., Series A, Vol. 165, No. 920, 18/3/38, pp. 73-87.) (54/14 Great Britain.)

The time variation of velocity at a fixed point in a turbulent airstream is analysed into a spectrum. The method adopted involves the use of the ordinary hot wire technique to produce changes of potential in a Wheatstone bridge circuit, which are magnified by a valve amplifier. The fluctuating voltage drop generated

across a resistance in the output circuit of the amplifier is then applied, in turn, to electrical filters having different cut-off frequencies. In each case the output current is measured with and without each filter in circuit, by means of a thermal milliammeter which indicates the mean value of the square of the current supplied to it. From the ratios of the readings taken with and without each filter, the spectrum curve is calculated by a method described in the appendix.

All measurements were made in a wind tunnel, at a point in the airstream where the turbulence created by a grid of regular mesh was known to be isotropic; the wind speeds used were 15, 20, 25, 30 and 35ft./sec.

Experimental Method for Studying Aerodynamic Ground Effect. (L. Viaud, Comp. Rend., Vol. 206, No. 11, 14/3/38, pp. 817-819.) (54/15 France.)

The proper study of ground effect in wind tunnel tests requires the provision of a moving belt. As this presents considerable experimental difficulties, the ground is often represented by a fixed plane boundary in close proximity to the model. This, however, introduces serious sources of error due to thickness of boundary layer if the model is placed some distance downstream from the nose of the boundary. On the other hand, if the model is placed near the leading edge, the flow is deflected and no longer follows the plane contour. The author overcomes this difficulty by placing a second model below its boundary in a position corresponding roughly to that of an optical image. The second model is adjusted till the static pressure on both sides of the plane boundary is the same and the measurements carried out on the original model can then be used to give the true ground effect. The second model need not be an exact replica of the first, its sole duty being to smooth out the flow along the plane boundary.

Graphical Determination of the Resistance Coefficient and Hydrodynamic Moment Acting on a Hydroplane Fitted with Wings and Determination of the Test Wing Setting. (E. Lorenzelli, L'Aerotecnica, Vol. 18, No. 1, January, 1938, pp. 64-77.) (54/16 Italy.)

The behaviour of a flying boat or float seaplane when " on the step " during the take-off process is difficult to study by means of tank tests. The author describes a graphical method for determining the resistance coefficient of a boat under these conditions assuring a certain altitude trim and velocity. The wing setting giving least total resistance is determined and the requisite aileron movements to facilitate take-off are deduced in so far as they affect the hydrodynamic moment and the natural attitude of the boat.

The results are given in the form of general characteristic curves which enable ready application of the experimental results to full-scale conditions.

A Preliminary Investigation of Boundary Layer Transition Along a Flat Plate with Adverse Pressure Gradient. (A. E. von Doenhoff, N.A.C.A. Tech. Note No. 639, March, 1938.) (54/17 U.S.A.)

Boundary layer surveys were made throughout the transition region along a smooth flat plate placed in an air stream of practically zero turbulence and with an adverse pressure gradient. The boundary layer Reynolds number at the laminar separation point was varied from 1,800 to 2,600.

The test data, when considered in the light of certain theoretical deductions, indicated that transition probably began with separation of the laminar boundary layer.

The extent of the transition region, defined as the distance from a calculated laminar separation point to the position of the first fully developed turbulent boundary layer profile, could be expressed as a function of the Reynolds number. Some speculations are presented concerning the application of the foregoing con-

cepts, after certain assumptions have been made, to the problem of the connection between transition on the upper surface of an aerofoil at high angles of attack and the maximum lift.

Flow in Smooth Straight Pipes at Velocities Above and Below Sound Velocity. (W. Frossel, Forschung, Vol. 7, March-April, 1936, pp. 75-84. Available as Translation T.M. 844.) (54/18 U.S.A.)

The flow conditions in smooth straight pipes at high air velocities are investigated. A relation is obtained between the quantity flowing through unit area, the pressure gradient along the pipe and the pipe length.

The friction coefficient λ is determined and compared with previous measurements of incompressible fluids. It appears that for high flow velocities the laws of Nikuradse may be applied to compressible fluids.

The velocity distributions over the cross section of the pipe were measured with a pitot tube and agree essentially with those previously obtained for incompressible fluids.

Finally, the behaviour of the compression shock in a smooth cylindrical pipe was investigated. The compression shock can occur at any position in the pipe, depending on the throttling downstream and travels upstream with increasing throttling up to the pipe entrance, so that thereafter only subsonic velocities occur in the pipe.

The Estimation of the Rate of Change of Yawing Moment with Sideslip. (F. H. Imlay, N.A.C.A. Tech. Note No. 636, February, 1938.) (54/19 U.S.A.)

Wind tunnel data are presented on the rate of change of yawing moment with sideslip for tests of nine complete aeroplane models, 20 fuselage shapes, and three wing models with various combinations of dihedral sweepback and twist. The data were collected during a survey of existing information, which was made to find a reliable method of computing the yawing moment due to sideslip. Important errors common to methods of computation used at present appear to be due to large interference effects, the investigation of which will undoubtedly require an extensive programme of systematic wind tunnel tests. At present it is necessary to place considerable reliance on past design experience in proportioning an aeroplane so as to obtain a reasonable degree of directional stability.

Nearing the Stratosphere. (D. W. Tomlinson, J. Aer. Sci., Vol. 5, No. 4, February, 1938, pp. 125-131.) (54/20 U.S.A.)

High altitude flights were carried out in a Northrop Gamma aircraft fitted with a Cyclone engine (500 b.h.p.) and exhaust driven supercharger. The object of the experiment was to determine

(*a*) The best method of supercharger control for operation at 30,000 feet.
(*b*) To determine the actual increase in speed with altitude.
(*c*) To check computed true air speeds by actual speed measurements at 30,000 feet.
(*d*) To make meteorological investigation at altitudes of the order of 30,000 feet (strength and direction of wind at the base of the stratosphere).

As there was some doubt as to the accuracy of the reduction of indicated air speeds at high altitude to true air speeds, a direct check was made by flying a triangular course at 30,000 feet, the turns being made under wireless control. The results substantiated the method of reduction and indicated an increase in true air speed of the order of 36 per cent. between sea level and 30,000 feet for the same engine power output. Cross country flights at 30,000 feet showed that very little is known about meteorological conditions at these altitudes and extensive research is recommended.

Wind Tunnel Tests on a Low Wing Monoplane with Propellers Running: Longitudinal and Directional Stability, Elevator Hinge Moments. (S. S. Miller and W. H. Albach, J. Aer. Sci., Vol. 5, No. 4, February, 1938, pp. 141-147.) (54/21 U.S.A.)

The model used was to one-sixth scale, the propeller being driven by a 12 h.p. electric motor giving the same linear velocities of the blade elements as in the full-scale aircraft. Under these conditions, the slipstream effects should closely resemble those existing on the actual aircraft.

It appears that the effect of power on static longitudinal stability (free elevator) consists of two parts—

(1) A change in the slope of the tail moment coefficient curve;
(2) A change in the intercept for any given change of tab angle from the neutral position.

A change in rudder angle does not affect the directional stability appreciably; the latter is, however, markedly increased if the engine is operating (" power on ").

The Activities of the U.S. Army Air Corps during 1937. (Inter. Avia., No. 526, 16/3/38, pp. 1-3.) (54/22 U.S.A.)

The following are some of the principal lines of development:—

1. Nose wheel landing gear.
2. Stability of tailless aircraft.
3. Radiators placed inside the wings.
4. Full feathering propellers.
5. New chrome molybdenum nickel alloy for valve steels.
6. Automatic recharging device in case of malfunction of aircraft gun.
7. Automatic landing devices.
8. Gyro magnetic compass.
9. Gyro stabilised drift meter.
10. Position line computer.
11. Individual lighting of instruments.
12. Colour photography.

Tank Tests of Model 36 *Flying Boat Hull.* (J. M. Allison, N.A.C.A. Tech. Note No. 638, March, 1938.) (54/23 U.S.A.)

N.A.C.A. model 36, a hull form with parallel middle body for half the length of the forebody and designed particularly for use with stub wings, was tested according to the general fixed trim method over the range of practical loads, trims and speeds. It was also tested free to trim with the centre of gravity at two different positions. The results are given in the form of non-dimensional coefficients.

The form of model 36 has many of the characteristics favourable for low hump resistance: Rather small dead rise; moderate angle of afterbody keel; moderate depth of step; long, straight forebody undersurface and high length beam ratio. Several of these features, involving the position of the afterbody with respect to the forebody, affect the resistance at high speed adversely when they improve it at hump speed. Good all-round performance depends upon adjusting the various factors until a satisfactory compromise is reached. Each flying boat design requires a different compromise. If the total air-plus-water resistance of a contemplated design using the hull form of model 36 gives a critical condition of excess thrust at high speeds with a large amount of excess thrust at hump speed, then the afterbody clearance could be increased to improve high speed performance at the expense of hump speed performance.

Model 36, in common with most conventional hulls, has a tendency to trim higher than best trim at the hump for practical positions of the centre of gravity.

Unpublished skeleton tests of the model with stub wings show that the stubs act to reduce the trim and the spread between free to trim and best trim. Further tests with various stubs and stub positions are contemplated.

Aircraft Efficiencies. (N. A. V. Piercy, The Engineer, Vol. 165, No. 4290, 1/4/38, pp. 374-376.) (54/24 Great Britain.)

The following are the author's main conclusions:—

1. The fixed wing is the most efficient lifting device at high speeds.
2. Although more research is required on form drag, the efficiency of wings can be calculated with fair accuracy.
3. Greatly increased wing loading increases efficiency and speed and makes large sizes possible.
4. Kinetic energy losses are becoming less important and aspect ratio may be reduced in large fast aircraft.
5. The efficiency of aeroplanes is rapidly approaching the optimum possible, unless major inventions intervene.
6. Much larger power units are predicted in the near future and the Diesel engine may come into favour for long range aircraft.

Supercharging a Pressure Cabin Aeroplane. (A. H. Johnson, J. Aeron. Sci., Vol. 5, No. 5, March, 1938, pp. 175-180.) (54/25 U.S.A.)

The paper refers to sub-stratosphere flight tests carried out on a Lockheed XC-35 aircraft built for the U.S. Air Corps. This machine is driven by two 500 b.h.p. Wasp engines, each provided with two exhaust driven superchargers. One of these superchargers is connected to the passenger cabin whilst the other provides the engine charge. The cabin supercharger could be connected in series or parallel. Pressure and air flow control was obtained by throttling the cabin supercharger intake and varying the size of the discharge opening. This adjustment had to be carried out by hand since a satisfactory automatic control is not yet available. A number of flights were carried out at altitudes up to 30,000 feet, the cabin pressure being maintained at the value corresponding to 10,000 feet. Although the tests have demonstrated the feasibility of supercharged cabin operation, considerably more experience will be wanted to render the scheme a commercial possibility. The development required is classified as follows:—

(1) Improvement in intercoolers for the engine superchargers.
(2) Replacement of exhaust driven cabin supercharger by gear driven types.
(3) Reduction in vapour pressure of fuels.
(4) Overcoming icing difficulties on windows.
(5) Improvements in hydraulic auxiliary systems so as to be less affected by cold.

Structural and Mechanical Problems Involved in Pressure (Supercharged) Cabin Design. (J. E. Younger, J. Aeron. Sci., Vol. 5, No. 5, March, 1938, pp. 181-5.) (54/26 U.S.A.)

This paper is a summary of the principal features of the laboratory investigations carried out at Wright Field during 1935 and 1936, on pressure cabins, the results of which formed the basis of the specifications of the first practical sub-stratosphere aeroplane, the Air Corps Model (Lockheed) XC-35. While these investigations have sufficient historical interest to make their presentation worth while, their principal value, however, lies in the fact that they were of a fundamental nature, and regardless of the perfection of the art, the principal results will still be applicable to the design of pressure cabin aeroplanes.

The Trend Towards Higher Altitudes in Commercial Air Transport. (W. B. Klemperer, J. Aeron. Sci., Vol. 5, No. 5, March, 1938, pp. 186-8.) (54/27 U.S.A.)

The structural problems of pressure cabins are readily reduced to well known principles so that they can be treated either theoretically or experimentally and they do not seem to obstruct the attainment of high flight altitudes in air transport. It seems that the immediate future of commercial higher altitude flying will be a step-by-step development: First, oxygen for the crew to ensure their mental alertness and protect them from insidious and accumulative effects of oxygen privation; second, " low-level air conditioning " oxygen service to passengers; third, pressure cabin supercharged to fractional pressure differential, without fully supercharging the engines; fourth, pressure cabin with supercharged engines. A gradual increase of ceiling would naturally accompany this development.

Helium versus Hydrogen in Airships. (G. Fulton, J. Aeron. Sci., Vol. 5, No. 5, March, 1938, pp. 208-210.) (54/28 U.S.A.)

After making due allowance for such factors as water recovery and superheat of the gas, the author concludes that the operating costs of a helium ship will exceed that of the equivalent hydrogen ship (same pay load) by about 10 per cent.

Reference is made to the possibility of discovering some dope which might reduce the inflammability of hydrogen and thus give a new lease of life to this gas for airship operation.

A certain measure of success has already been achieved by the use of tin compounds. Unfortunately these chemicals also reduce the lift, but the possibility of obtaining a commercial solution of the problem must not be ruled out.

Interference of Wing and Fuselage from Tests of 18 Combinations in the N.A.C.A. Variable Density Tunnel Combinations with Split Flaps. (A. Sherman, N.A.C.A. Tech. Note No. 640, March, 1938.) (54/29 U.S.A.)

As part of the wing fuselage interference investigation in progress in the N.A.C.A. variable density wind tunnel, the effects of various split flap arrangements applied to wing fuselage combinations were determined. Split flaps were found to exert their influence independently of the interference, and their effects on the aerodynamic characteristics of rectangular aerofoil combinations appeared to be more or less proportional to their exposed span lengths. The interference, moreover, showed the same character with the split flaps as without them.

Coupled Wing Fuselage Vibrations. (K. Sezawa and W. Watanabe, Aer. Res. Inst., Tokio, Report No. 160, Jan., 1938, pp. 171-94.) (54/30 Japan.)

The authors have studied the nature of the coupled vibrations of the main wing and the fuselage, both of which are of varying mass distribution and cross section, the effect of the concentrated mass at the engine gondola being also taken into account. The mathematical part involves mainly a treatment by Bessel's functions, whilst the experiments deal with the study of the forced vibrations of a celluloid model. Both theory and experiment are in fair agreement as to resonance frequencies, vibrational modes, etc. In the case of symmetrical wing vibration the wing is in a quiescent state at a frequency quite near the resonance condition. The vibrational amplitudes of the fuselage are not generally large. In the case of symmetrical wing deflection, notwithstanding the coupled condition of the wing and the fuselage, it is possible to assume that the half wing span is a cantilever bar and the condition of the fuselage at the wing root corresponding to that of a hinge. In the case of anti-symmetric wing deflection no nodal point exists in the fuselage and the vibrational condition of that fuselage at the wing root corresponds to that of a fixture. In this case only the inertia of the fuselage becomes operative.

Testing Bearing Metals Under Dynamic Loads. (H. O. Heyer, Autom. Tech. Zeit., Vol. 40, No. 22, 25/11/37, pp. 551-9, and No. 23, 10/12/37, pp. 589-95. Eng. Absts., Vol. 1, No. 1, Jan., 1938, p. 17. See also Translation No. 586.) (54/31 Germany.)

The author explains, by means of the usual polar diagram with indexed co-ordinates, how the load varies and shifts in the bearings of internal combustion engines. An improved diagram in three dimensions is added to emphasise the main characteristics of the load variation, and from this he develops the possibility of imitating service conditions in a bearing testing machine. While the bearing is rotating a load is imposed periodically by an oscillating toggle mechanism in which a compact capsule is embodied to measure the load. The eccentric actuating the toggle has an adjustable throw and the load extension characteristic of the capsule plus frame can be calibrated. The author discusses the possible devices available for the capsule, namely, a condenser, a carbon or liquid resistance or an inductance; all three involve indirect and often erroneous measurements; alternatively, use may be made of ferro-nickel alloys giving direct magnetic effects under stress, or piezo quartz with electric charge variations under stress. The last mentioned was used, and the circuits and calibration curves are shown. The author states that it is possible to predict service results after not more than 10 million revolutions in the testing machine. From the studies made so far on this machine he has been enabled to deduce the most suitable general structures of lead bronze, and other bearing metals. In white metal bearings fatigue failure of the more brittle components is a principal cause of bearing failure.

Improvements in the Bearing Qualities of Pistons of Motor Car Engines. (E. Koch, Z.V.D.I., Vol. 81, No. 51, 18/12/37, pp. 1458-60. Eng. Absts., Vol. 1, No. 1, Jan., 1938, p. 9.) (54/32 Germany.)

The author remarks that as pistons are usually either ground or diamond-turned, the surface has grooves at right angles to the direction of friction and these grooves must be worn down in service; he includes a number of photo-micrographs showing the original grooves and the worn surfaces. If the wear is uneven and irregular, the conditions of lubrication and cooling become hazardous and dubious, so that wear is sure to be more rapid and damaging than with even, continuous conditions. From this basis the author gives photo-micrographs of pistons untreated and treated by the electric oxidation process (Eloxieren) and by a newly developed tinning process. He shows that, whilst the untreated piston is subject to strong local corrosion and pitting, the electrically oxidised surface is inclined to seize on account of the harsh erosive action of the oxide on the cast iron cylinder wall, and the consequent lapping action produced by embedded abrasive. The tinned surfaces, on the other hand, show rapid running-in properties and an early stabilisation of a smooth surface which wears but little. The author states that tinned aluminium alloy pistons have been in service in various automobiles since August, 1936, and that with these pistons the running-in time is less than one hour. The tin needed per piston of about 3in. diameter is only about 1.5 gram (1/300lb.) and the time required by the tinning operation, including all preparatory and finishing operations, is only a few minutes.

Theoretical and Experimental Investigation on the Combustion Processes of Spark Ignition and Diesel Engines. (F. A. F. Schmidt, L.F.F., Vol. 14, No. 12, 20/12/37, pp. 640-6. Eng. Absts., Vol. 1, No. 2, Feb., 1938, p. 23.) (54/33 Germany.)

Approximate calculations were made of the time required for, and of the mean temperature increase during, the vaporisation of a droplet of fuel. The author concludes that, even with the very short ignition delay periods observed in oil engines, the greater part of the fuel has already been vaporised when ignition

commences, so that a theoretical relationship between the total ignition delay and the time required for vaporisation cannot be established. The ignition delays observed in closed combustion vessels and Diesel engines are discussed, and emphasises the importance of turbulence emphasised. Diagrams indicate the influence upon the ignition delay of the air density and temperature at the end of the compression period, which materially affect the output of Diesel engines in aircraft flying at great heights. With the object of investigating the " knocking limits " in spark ignition engines, tests were carried out under supercharged conditions with higher charge temperatures at various timings of the ignition and with various excess air ratios. The author discusses in detail his conclusions in regard to the process of combustion and the origin of " knocking."

Mixture Formation and Combustion in High Speed Diesel Engines. (K. Zinner, Z.V.D.I., Vol. 82, No. 1, 1/1/38, pp. 9-14. Eng. Absts., Vol. 1, No. 2, Feb., 1938, p. 24.) (54/34 Germany.)

The author observes that the Diesel is being utilised more and more in the form of small cylinder, high rotational speed engines. With the higher speeds the time available for the formation of a suitable air/fuel mixture is reduced and the difficulties of control and metering are correspondingly increased. The author explains how, by the use of a combustion efficiency and a wall coefficient, the influence of various factors in mixture formation can be determined. The wall coefficient depends upon the cylinder surface per unit volume and upon the heat transfer at the surface; these factors depend upon the effective turbulence. The combustion efficiency depends upon the speed and completeness of combustion, and these in turn depend upon the jet penetration and turbulence in the cylinder. With increase in shaft speeds the energy of mixture formation must increase, and in the calculation of the overall efficiency account must be taken of the mixture-forming energy. At low speeds vigorous turbulence is wasteful on account of the increased heat losses, but with very high shaft speeds and piston speeds the heat losses due to turbulence are more than compensated by improved combustion.

Power and Economy of Mixture Scavenged Two-Stroke Engines. (U. Schmidt, Autom. Tech. Zeit., Vol. 40, No. 24, 25/12/37, pp. 605-613. Eng. Absts., Vol. 1, No. 2, Feb., 1938, p. 23.) (54/35 Germany.)

The author discusses the principal conditions governing two-stroke engine output and economy; the results are presented in graphs, many of which agree closely with the results of calculation. One of the chief factors governing power and economy is the exhaust system. The author indicates two main pressure time characteristics of the exhaust. In one of these the trough of the pressure wave is rounded, the optimum results are confined to a narrow speed range. In the other, with a longer and flatter trough, the speed range for good results is much wider. The flat characteristic is produced by the series coupling of a volume and an acoustic filter through a throttle. If the sound intensity of the exhaust system is plotted on an engine speed basis in phons, the ordinates are substantially constant from 2,000 r.p.m. to 4,000 r.p.m. With no silencer the average reading is about 135 phons; with the usual forms of silencer the mean value is about 120 phons; whilst with the acoustic filter system the noise intensity is about 95 phons. Cross sections of two acoustic filters using glass wool lagging are reproduced.

New Single Cylinder Test Plant of the D.V.L. (W. D. Bensinger, Autom. Tech. Zeit., Vol. 40, No. 24, 25/12/37, pp. 621-3. Eng. Absts., Vol. 1, No. 2, Feb., 1938, p. 22.) (54/36 Germany.)

The author describes the reconstruction of a single cylinder research unit installed in 1933; the alterations made were based upon the experience obtained with the initial unit. The principal features are welded steel construction for

bed-plate and crankcase and a variable compression adjustment by which the cylinder is raised and lowered, after which it is fixed by four stout bolts. Special pumps are fitted, and also two magnetos which can run together with or without separate adjustment, combined with crankshafts giving 110 mm., 124 mm., 130 mm., 140 mm., and 162 mm. stroke; by this means a wide experimental range is rendered available. Either air-cooled or water-cooled cylinders can be utilised. For two experimental cylinders of 130 mm. and 135 mm. bore, with strokes of 130 mm. and 140 mm. respectively, four vertical valves were employed, and also a valve gear based upon sliding helical gears. This valve gear permits adjustment of the valve timing and valve lift during the test. The former valve gear allowed speeds ranging up to 2,200 r.p.m.; the new gear has been found satisfactory at shaft speeds of 3,200 r.p.m. and with valve lifts ranging up to 13 mm. ($\frac{1}{2}$in.).

Heat Transfer Processes in Air-Cooled Engine Cylinders. (B. Pinkel, N.A.C.A. Report No. 612, 1938.) (54/37 U.S.A.)

From a consideration of heat transfer theory, semi-empirical expressions are set up for the transfer of heat from the combustion gases to the cylinder of an air-cooled engine and from the cylinder to the cooling air. Simple equations for the average head and barrel temperatures as functions of the important engine and cooling variables are obtained from these expressions. The expressions involve a few empirical constants, which may be readily determined from engine tests. Numerical values for these constants were obtained from single-cylinder engine tests for cylinders of the Pratt and Whitney 1535 and 1340-H engines. The equations provide a means of calculating the effect of the various engine and cooling variables on the cylinder temperatures and also of correlating the results of engine cooling tests. An example is given on the application of the equations to the correlation of cooling test data obtained in flight.

Soundproofing of Control Cabins for the Testing of Aircraft Engines. (I. Katel, Génie Civil, III, 25/12/37, pp. 544-6. Eng. Absts., Vol. 1, No. 2, Feb., 1938, p. 33.) (54/38 France.)

The author describes control cabins constructed for the French Air Ministry at Bordeaux. The object was that the sound level of the noise from the engines (110-125 decibels, measured at the test bench) should not exceed about 65 decibels in the interior of the cabins. The soundproofing of the walls did not present so much difficulty as that of the doors and windows, and especially that of the numerous small apertures required for the passage of control rods, pipes, cables, etc. The author states that reduction of the area of an aperture in the ratio of 100 to 1 results in a reduction of only 40 per cent. in the physiological intensity of the sound transmitted. Each cabin is situated between two test benches and has two floors, each about 21ft. by 13ft., the control post and all the necessary measuring instruments being on the upper floor. The walls consist of two rows of solid brickwork separated by " katelit " insulating slabs. The ceiling, of reinforced concrete, rests only on the interior rows of brickwork and is covered by slabs of " absorbit," continued to meet the insulation of the walls and protected by a rendering of cement, and by a single-span roof. The upper floor is insulated from the walls, and the walls from the ground, by slabs of " asphalted korsil," and the lower floor is insulated from the ground by a layer of " antiphon." The results of tests made by three different methods indicate an average of 54 decibels as the difference between the sound level near the engine and that inside the cabin.

The Fundamental Principles of the N.A.C.A. Cowling. (T. Theodorsen, J. Aeron. Sci., Vol. 5, No. 5, March, 1938, pp. 169-174.) (54/39 U.S.A.)

The cowling performs two distinct functions:—

(1) It provides a streamline enclosure of minimum drag.

(2) It provides a certain pressure difference across the engine.

The nose design of the cowling is not critical. The angle of the front camber line should be of the order of 45° with the axis and the openings as large as is consistent with these requirements.

The skirt design, on the other hand, is rather critical and depends on the engine conductivity* and the pressure difference required across the engine. The skirt edge must neither project into the external airstream nor project inwards. The mean flow line must be parallel to the external flow and some means of changing the exit conductivity must be provided to prevent excessive losses at high speed. This is best done by decreasing the area of the exit slot. At low air speeds, the cooling must be improved either by fitting cowl flaps or providing a nose slot. In either case the proper shape of the propeller boss has an appreciable influence.

Flight Analysis of the Sounding Rocket. (F. J. Malina and A. M. O. Smith, J. Aeron. Sci., Vol. 5, No. 5, March, 1938, pp. 199-202.) (54/40 U.S.A.)

The authors calculate the vertical flight in vacuo of a rocket on the assumption of a constant exhaust velocity and neglecting variations in gravity acceleration.

The investigation is then extended to the case of flight through a resisting medium, assuming a variation of the resistance coefficient with speed similar to that obtained with shells.

It appears that in this case there exists a limiting value for the initial acceleration which gives the greatest altitude. A high velocity of flight through the lower strata of the atmosphere causes a rapid consumption of combustible and for this reason it is advantageous to start the rocket at a high initial altitude.

The case of a composite rocket is considered, the lightest element being fired last for which theory indicates a maximum altitude of the order of 1,000 miles.

Media for Overcoming Drop in Power Associated with the Use of Gaseous Fuels in I.C. Engines. (W. Rixmann, Z.V.D.I., Vol. 81, No. 47, 20/11/37, pp. 1357-63. Eng. Absts., Vol. 1, No. 1, Jan., 1938, p. 9.) (54/41 Germany.)

The principal gas fuels used in the experiments were propane, methane, town's gas, and " fluid gas " consisting of a mixture of butane and propane. The tests were made with a lorry engine of 120 mm. bore by 160 mm. stroke, giving a swept volume of 10.85 litres, and a high-speed engine of 79 mm. by 117.5 mm. with a swept volume of 3.49 litres, developing its maximum power at 3,200 r.p.m. The author emphasises the importance of maintaining a high volumetric efficiency. To this end he uses two forms of inlet manifold, one with carburettor and gas mixer in parallel and the other with a series arrangement. Using calorific value, volumetric efficiency, and brake thermal efficiency, he calculates the decrease in power in changing from petrol to gas; the results agree very closely with experiment. The experimental results are presented in tables and curves.

Piston Lubrication. (C. M. Larson, Autom. Eng., Vol. 28, No. 369, March, 1938, p. 105.) (54/42 Great Britain.)

Highly solvent treated oils have been shown to be deficient in lubricating value, and ring sticking caused by excessive blow-by has resulted. Such high output petrol and Diesel engines will operate on straight mineral oils at reduced loads; but reduced cylinder wear, freedom from ring sticking and sludge reduction can be had only with proved addition agents. The highly refined paraffinic base oils plus oiliness addition agents are the most effective for high output petrol engines,

* The engine conductivity is a number expressing the effective free passage area for the air in terms of the nacelle cross-section. For single row radials it is of the order of .065, *i.e.*, in the case of a nacelle 50in. diameter the effect of the engine is similar to that of 250 sharp-edged orifices each 1in. in diameter.

whereas the naphthenic base oils plus entirely different addition agents are best suited for Diesel engines.

High output petrol and Diesel engine research has shown that a lubricant, to reduce ring and cylinder liner wear and give freedom from ring sticking, should consist of a very stable vehicle plus an addition agent which has proper film strength and adhesion, as well as resistance to corrosion and oxidation.

The Viscosity of Hydrocarbons. (E. B. Evans, J. Inst. Petrol. Tech., Vol. 24, No. 171, January, 1938, pp. 38-53.) (54/43 Great Britain.)

During the last half century a large amount of experimental data on the viscosities of hydrocarbons has been accumulated during the course of numerous investigations into the relationship of chemical constitution and viscosity and the dependence of viscosity on temperature. More recently results have been published on some of the hydrocarbons of higher molecular weight and more complex structure, such as might be expected to occur in the higher boiling fractions of petroleum, and especially in lubricating oils.

An attempt has been made here to review critically this mass of data and to present the most reliable and accurate of the results in tables showing viscosities in absolute and in kinematic units at certain standard temperatures, viz., 0°C., 20°C., 50°C., 80°C. and 100°C. The figures tabulated have been obtained by plotting the available experimental data and using the values obtained from these curves.

The results are then readily available for the examination of constitutional or temperature effects on about 150 hydrocarbons, including 38 which have been examined experimentally in the course of this work.

New Measurements of the Velocity of Sound in Free Air. (T. J. Kukkamaki, Ann. d. Phys., Vol. 31, No. 5, March, 1938, pp. 398-406.) (54/44 Finland.)

As an exact knowledge of the velocity of sound in free air is of considerable military importance, fresh experiments were carried out under the auspices of the Finnish military authorities. The sound was provided by the explosion of 1 kg. of explosive fixed on a stake at 1 m. above the surface of the earth and the measurements were carried out with electrical microphones over a base of 1 km. in both directions so as to eliminate wind effects. The first value obtained was 330.77 ± 0.064 m./sec. for still dry air at 0°C.

This applies to the type of sound experimented with (frequency below 1,000/sec.).

For sounds of high frequencies, the author favours the value 331.7 m./sec.

The Application of Aerial Photogrammetry to the Determination of Aircraft Speeds and Training in Bomb Dropping. (M. Niotri, 4th International Congress on Photogrammetry, Paris, 1934, pp. 291-302.) (54/45 Italy.)

A number of vertical photographs of the ground are taken from the aircraft at known intervals of time. The territory must possess a sufficient number of landmarks, the relative position of which is accurately known. From the rectified photographs the position of the aircraft in space at the instant of taking the view can be found and the velocity follows from the known time interval for the passage of a given base.

It is stated that the true ground speed can be determined to within 1 per cent. (the base line being 3 km.) for speeds of the order of 400 m.p.h. at an altitude of 6,000 feet.

The method is also applicable to bomb dropping exercises; one photograph of the ground is taken at the instant of fictitious bomb release whilst a second ground view is taken about 20 seconds later. From these photographs it is possible to calculate—

(*a*) The position of the aircraft at the instant of release.
(*b*) The plane of drop.
(*c*) The speed of the aircraft, *i.e.*, initial horizontal speed of bomb.

The author states that this method is preferable to the alternative of photographing the aircraft from the ground by means of a photo-theodolite. (See also M. Vauzou, 4th International Congress on Photogrammetry, Paris, 1934, pp. 247-90, and C. Bourgues, Rev. de l'Arm. de l'Air, No. 96, July, 1937, pp. 789-98.)

The German Land Plane Speed Record—Details of Measuring Instruments. (W. Rossmann Luftwelt, Vol. 5, No. 3, March, 1938, pp. 88-92.) (54/46 Germany.)

The aircraft passing either end of the 3 km. base is photographed by means of high speed cine cameras situated at right angles to the base. Each camera is provided with a series of counters which are driven at a uniform speed under tuning fork control. The position of these counters at the moment of exposure is recorded on the film and enables the position of the aircraft relative to the ends of the base to be fixed to within 1/1000 sec. (50 pictures per second).

This camera was originally designed by the Reichsanstalt for the Olympic Games and its adaptation for the present purpose created some difficulty on account of the relatively great distance between the two units. The final synchronisation is obtained by means of a standard chronometer and a special low resistance electrical cable.

Shear Distribution in a Sheet Metal Box Spar. (H. W. Sibert, J. Aer. Sci., Vol. 5, No. 4, February, 1938, pp. 134-7.) (54/47 U.S.A.)

Within the last few years many aeroplane designers have become interested in the construction of wings in which the entire bending and torsion is carried by a single sheet metal box spar. One great difficulty in designing such a spar has been the question of shear distribution along a cross section. In the present paper simple formulæ for the shear distribution are given which can be applied to a sheet metal box spar of any shape whatsoever, whether or not the skin contributes anything to the strength in bending. In addition, a simple graphical method for determining the shear centre for such a box spar is given.

Preliminary Fatigue Studies on Aluminium Alloy Aircraft Girders. (Goodyear Zeppelin Corporation, N.A.C.A. Tech. Note No. 637, Feb., 1938.) (54/48 U.S.A.)

Preliminary information on the complex subject of the fatigue strength of fabricated structural members for aircraft is presented in the test results obtained on several different types of airship girders subjected to axial tension and compression in a resonance fatigue machine. A description of this machine as well as numerous photographs of the fatigue failures are given. There is also presented an extended bibliography on the subject of fatigue strength.

Studies of Surface Layers of Materials. (N. N. Sawih, Science et Ind. (Mécanique), No. 21, Nov.-Dec., 1937, pp. 269-75. Eng. Absts., Vol. 1, No. 1, Jan., 1938, p. 13.) (54/49 France.)

The author describes the Skoda-Sawin wear testing machine, in which a disc is rotated and pressed into the surface under test, and indicates that the volume abraded is directly proportional to the number of revolutions of the disc. For hardened steel the rate of wear is approximately 0.5 cu. mm. per 15,000 revolutions. The normal speed of the disc, which has a diameter and width of 30 by 2.5 mm. respectively, is 675 r.p.m. and the test piece is cooled by a stream of 0.5 per cent. K_2CrO_4 solution in distilled water. The wear of the widia disc

is remarkably slight; even after 6×10^6 revolutions, or say 2,000 specific tests of different tool steels, its diameter is reduced by only 0.003 mm. The author concludes that all surfaces of machined or polished materials are under tension and that the tension depends on the past history of the specimen. The surface tension is greater in polished or finished specimens, and the abrasion is correspondingly greater in these polished specimens even to depths of 100 μ. The author ascribes the main variations and the inconstancy of wear effects to internal tensions in the material, and he states that these are greater in polished than in unpolished specimens. In all the tests, using various tool steels variously prepared, no relation between hardness numbers and wear values could be detected.

Analysis of Bolted Joints at High Temperatures. (E. O. Waters, J. App. Mech., Vol. 5, No. 1, March, 1938, pp. A7-10.) (54/50 U.S.A.)

A preliminary study shows that the flanges in a typical bolted joint for piping have a more nearly uniform, and hence more favourable, stress distribution after creep has occurred than when the joint is first tightened up. However, the tightness of the joint depends on the initial elastic stretch of bolts and flanges; hence an estimation of its durability at high temperature is really a compound relaxation problem, and the advantage to be gained by the quasi-uniform stress distribution is apt to be illusory.

Effect of Temperature on Physical and Optical Properties of Photo-elastic Materials. (G. H. Lee and C. W. Armstrong, J. App. Mech., Vol. 5, No. 1, March, 1938, pp. 11-12.) (54/51 U.S.A.)

This paper reports the results of tension tests, to determine the suitability for photo-elastic work, of five samples of Bakelite and two of marblette at temperatures between 32 and 140°F. These results show the variation of Young's modulus, Poisson's ratio, stress-optical coefficient, and strain-optical coefficient with temperature. Stress-strain curves of the materials are also given showing the relative amounts of creep. The effect of heat treatment on marblette is shown by tests before and after annealing.

Rubber Mountings. (J. F. D. Smith, J. App. Mech., Vol. 5, No. 1, March, 1938, pp. 13-23.) (54/52 U.S.A.)

This paper deals with static deflections of rubber mountings. An equation has been developed which correlates all the available data on plain rectangular slabs under compression loading. Data are given showing how closely this equation checks experimentation, and examples are solved, giving the method of using this equation and also the use of a chart simplifying the calculations. Additional data are given on other shapes of compression mountings.

The deflections of shear type mountings are shown to agree with theory. Combination shear compression units have also been tested.

Data are given showing the variation of hardness on the durometer A scale with change of temperature. At room temperature moduli of elasticity for compression and for shear are related with durometer hardness number, and the equations of these curves are derived.

A Rapid Method for the Determination of Principal Stresses Across Sections of Symmetrical Form from Photo-elastic Data. (M. M. Frocht, J. App. Mech., Vol. 5, No. 1, March, 1938, pp. 24-8.) (54/53 U.S.A.)

The author discusses: (*a*) Mesnager's theorem of isoclinics, (*b*) the characteristic curve of tangential stresses across a section of symmetry, (*c*) a formula for the maximum tangential stresses for the case of a central circular hole between fields of pure tension, (*d*) the slope of the p curve at a point corresponding to a cupic point, (*e*) recent improvement in the determination of free boundary stresses, and (*f*) formulæ for the position of cupic points for two cases.

A new method for the determination of the principal stresses across sections of symmetry from photo-elastic data is illustrated with three examples:—(1) Bars in tension or compression with central circular holes, (2) grooved beams in bending, and (3) rings or discs with circular central holes subjected to two concentrated diametral loads.

Creep of Metals at High Temperatures in Bending. (E. A. Davis, J. App. Mech., Vol. 5, No. 1, March, 1938, pp. 29-31.) (54/54 U.S.A.)

The author develops a theory for plastic bending and obtains equations for the creep due to bending. Results of tests on a chromium-nickel composition are given to show the agreement between the experimental and theoretical results.

The Buckling of Curved Tension Field Girders. (G. Limpert, L.F.F., Vol. 14, No. 7, 20/7/37, pp. 356-60. Available as Translation T.M. 846.) (54/55 Germany.)

The author describes reports of experiments on the buckling load under shear of circular curved tension field webs. The buckling load of the webs can be expressed in terms of the buckling load of the stiffeners. Within the experimental range the buckling load is approximately twice as great as that of the identically stiffened flat wall of equal depth of web.

Stresses in Reinforcing Rings Due to Axial Forces in Cylindrical and Conical Stressed Skins. (K. Drescher and H. Gropler, L.F.F., Vol. 14, No. 2, 20/2/37, pp. 63-70. Available as Translation T.M. No. 847.) (54/56 Germany.)

At the ends of a monocoque fuselage concentrated axial forces in the skin must generally be taken up. Such axial forces must also be taken up in the case of other members where axial forces from the neighbouring stressed skin construction must be considered. In order to take up these axial forces two bulkheads or reinforcing frames may be arranged at the positions where the forces are applied. If these bulkheads are in the form of rings, bending moments are set up in them. In the present paper computations are performed for obtaining the value of these bending moments. It is assumed that the stressed skin is cylindrical or conical and that its cross section is circular or elliptical.

Fire Tests on Treated and Untreated Wood Partitions. (C. R. Brown, Bur. Stan. J. Res., Vol. 20, No. 2, Feb., 1938, pp. 217-39.) (54/57 U.S.A.)

Fire endurance tests were made of 13 wood partitions 4ft. square and of four partitions 10ft. high and 16ft. wide. Some of the smaller partitions were of untreated long leaf pine, while the others were made of long leaf pine impregnated with various amounts of monoammonium phosphate up to 17 per cent. by weight. They were built either of one, two, or three plies of $\frac{3}{4}$in. boards, or of a $1\frac{3}{4}$in. core with $\frac{3}{16}$in. veneers, giving a total thickness of $2\frac{1}{8}$in. The large partitions were of the latter design and were made of treated birch. The results of the tests of the small panels are compared with results of fire tube and flame penetration tests made on specimens representative of each panel.

Note on Galerkin's Method of Treatment of Problems Concerning Elastic Bodies. (W. J. Duncan, Phil. Mag., Vol. 25, No. 169, April, 1938, p. 628.) (54/58 Great Britain.)

The method of Galerkin may be looked at from two distinct view points:—

(*a*) As a process for the approximate solution of differential equations.

(*b*) As a means for quickly and easily applying Lagrange's principle of virtual work to problems in the statics and dynamics of elastic and other continuously deformable bodies.

The method is considered from both points of view in No. 1798 of the Reports and Memoranda of the Aeronautical Research Committee, which also contains numerous examples of its applications to such problems as the flexural and torsional oscillations of beams, the critical behaviour of struts, and the solution of linear ordinary and partial differential equations. In the present short note attention is mainly confined to the application of the method to the flexural motion of a cantilever, since this affords an excellent illustration of the principles involved.

Application of the Galerkin Method to the Torsion and Flexure of Cylinders and Prisms. (W. J. Duncan, Phil. Mag., Vol. 25, No. 169, April, 1938, p. 634.) (54/59 Great Britain.)

The paper shows that the Galerkin method can be readily applied to the St. Venant torsion problem and to the St. Venant problem of the flexure of a cantilever under tip load. The following three cases of torsion are treated in detail:—(*a*) Cylinder of aerofoil section; (*b*) cylinder of parabolic lenticular section; (*c*) rectangular prism. It is shown that the solutions obtained by the Galerkin method agree closely with those obtained by other methods. A simple formula for the torsional stiffness of a cylinder whose section is narrow and symmetrical, but otherwise arbitrary, is obtained. This formula is accurate in the case of an elliptic cylinder. It is shown that the shearing stresses in the flexure problem and the position of the flexural centre can easily be found, and applications are made to the elliptic cylinder and to a cylinder of aerofoil profile.

Creep of Metals at High Temperature in Bending. (E. A. Davies, J. App. Phys., March, 1938, pp. 29-31. Metropolitan Vickers Technical News Bulletin, No. 605, 8/4/38.) (54/60 Great Britain.)

The author develops a theory for plastic bending and obtains equations for the creep due to bending. Tensile and bending tests were carried out at 1,500 and 1,652°F. on a chromium-nickel composition. Results of these tests are given for the purpose of comparison with theoretical results. Illustrated with seven diagrams.

Electron Diffraction Applied to Corrosion Study. (I. R. Landau, Metals and Alloys, March, 1938, pp. 63-7. Metropolitan Vickers Technical News Bulletin, No. 605, 8/4/38.) (54/61 Great Britain.)

The view is advanced that prevention of corrosion of metals depends largely on the formation of protective oxide films. Hence it is suggested that the study of such films will yield more useful results than can be obtained by trying out various alloys. Methods of studying surface films by electron diffraction, and Thomson-Fraser and Finch types of electron camera are described. Illustrated with five photographs and two diagrams.

Physiological Considerations Governing High Altitude Flight. (J. W. Heirn, J. Aeron. Sci., Vol. 5, No. 5, March, 1938, pp. 189-192.) (54/62 U.S.A.)

The author considers the effects of reduced pressure and oxygen concentration on the human organism and concludes that high altitude flying becomes only feasible if a sealed aircraft compartment is provided. Such a compartment presents certain physiological problems, such as

(1) Temperature control.
(2) Humidity control.
(3) Ventilation.
(4) CO content.
(5) CO_2 content.
(6) O_2 content.
(7) Absolute pressure.

The first three items on this list should not present great difficulties in view of recent advances in the science of air conditioning. The last four items have been investigated experimentally. It appears that a sudden rupture of the cabin will not be catastrophical, provided that lower levels can be reached before the symptoms of compressed air sickness and anoxemia have time to become manifest.

The Influence of Aviation Medicine on Aircraft Design and Operation. (H. G. Armstrong, J. Aeron. Sci., Vol. 5, No. 5, pp. 193-198.) (54/63 U.S.A.)

An accident attributed to error of judgment of the pilot may be due to any of the following reasons:—

(1) The pilot was not mentally or physically fit.
(2) Inexperience.
(3) Fatigue due to the trying conditions under which the work of pilotage has to be carried out.

Fatigue may be due to noise, lack of oxygen, changes in altitude, or concentration on instruments (blind flying).

The examination for the acceptance of a pilot calls for physical normality in all respects, stability of nervous system and intelligence.

It is very difficult to combine these three desiderata in one individual and the deleterious effects of the conditions under which he has to work cause a rapid wastage.

The human element in flight is the weakest link and progress will only be made if as much care is taken in designing for the pilot's comfort as is at present expended on increasing the pay load.

Some Aspects of Magnetic Recording and its Application to Broadcasting. (A. E. Barrett and C. J. F. Tweed, J. Inst. Elec. Eng., Vol. 82, No. 495, March, 1938, pp. 265-88.) (54/64 Great Britain.)

This paper presents a somewhat simplified consideration of the processes occurring in the magnetic recording of sound on steel tape, and describes some of the apparatus and methods used in this country in its application to broadcasting.

A brief historical account is given of the early uses of magnetic recording. The essential processes involved are then discussed in a simplified form, and the effects of the finite longitudinal spread of the recording field, and of the self-demagnetisation of the tape, are considered before the question of background noise is introduced.

In the next section certain fundamental experiments are described, followed by a brief account of various possible methods of saturating, recording, and reproducing. Considerations relating to the conditions for the optimum working of any particular arrangement are put forward, with the results of tests of two of those which are now in use. Some details are given concerning the tape itself, after which a recording machine is described.

The paper concludes with a short account of the technical and programme service requirements for a recording system for use in connection with broadcasting, and a description of a recording channel at the British Broadcasting Corporation's premises at Maida Vale.

Directional Recording of Radio Atmospherics. (F. E. Lutkin, J. Inst. Elec. Eng., Vol. 82, No. 495, March, 1938, pp. 289-302.) (54/65 Great Britain.)

The paper describes an improved recorder indicating the direction of arrival of transient impulses continuously throughout the day. The polar diagram of the receiver has a width of 20° and is unambiguous. The analysis of three years' records shows that most of the atmospheric disturbance reaching a station in England arrives from the west or south-west, but that during summer afternoons sources to the east and south-east are productive together with storms of a purely

local character. The disturbed azimuths appear closely related to the bearing of the great tropical thunderstorm centres, but the intensity of disturbance from each is dependent on the ionisation conditions prevailing over the path to the receiver, at the time each region is productive. Curves are given from which the probable intensity of atmospheric in any direction at any time may be roughly determined.

Recent Developments in Magnetic Materials. (C. E. Webb, J. Inst. Elec. Eng., Vol. 82, No. 495, March, 1938, pp. 303-24.) (54/66 Great Britain.)

A review is given of recent developments in magnetic materials, including alloys for permanent magnets, "soft" materials having large initial and maximum permeabilities and materials with constant permeability over a wide range of magnetising force. Particular reference is made to dispersion-hardening alloys, the attainment of high degrees of purity in iron and iron alloys, improvements in sheet materials, the properties of nickel irons, and of complex alloys based on them, after various thermal, magnetic, and mechanical treatments, and the characteristics of powdered materials.

Radio Emergency Procedure. (H. W. Roberts, Aero Digest, Vol. 32, No. 3, March, 1938, p. 27, 160-1.) (54/67 U.S.A.)

Recently an air liner carrying passengers on a scheduled 35 minutes flight lost its bearings and had to stay six hours in the air before landing. It appears that the flight crew of a modern air liner is overburdened and can only fulfil their manifold duties so long as all goes well. To prevent a similar emergency arising in future, the author put forward the following recommendations:—

1. Radio operator-navigator should be carried on all scheduled flights in addition to pilot and co-pilot.
2. Improved modern types of aircraft radio direction finders should be carried in scheduled operations.
3. Standardised rules for radio emergency procedure should be promulgated and enforced.
4. Duplication of transmitting equipment on scheduled operations.
5. Ground direction finders for aircraft should be installed at strategic airports.
6. Qualified pilots, familiar with the equipment and the terrain should be on call at ground stations.
7. Standardised radio procedure for aircraft should be under government control.

Direct Viewing Type Cathode Ray Tube for Large Television Images (18*in.* by 24*in.*). (I. G. Maloff, R.C.A. Review, Vol. 2, No. 3, January, 1938, pp. 289-96.) (54/68 U.S.A.)

A new device for obtaining large bright television images of high contrast and high definition has been developed at the Camden Laboratories of the R.C.A. Manufacturing Company. It is a direct viewing cathode ray tube $4\frac{1}{2}$ feet long and 31 inches in diameter. It is of the continuously evacuated type and gives a picture 18 by 24 inches in size. The paper describes the design and construction of the new tube, the reasons for the development, the difficulties which were overcome and the results obtained.

A New Principle in Directional Antenna Design. (W. W. Hansen and J. R. Woodyard, Proc. Inst. Rad. Eng., Vol. 26, No. 3, March, 1938, pp. 337-45.) (54/69 U.S.A.)

It is shown that in certain types of directional antenna arrays the gain can be increased by arranging so that waves going from the array elements in the direction of maximum transmission are not strictly in phase at large distances.

Two examples correspond to the kind of directivity generally desired in a broadcast antenna. One of these consists of short antennas placed in concentric rings. A typical array of this type containing 22 short antennæ with the radius of the outer ring equal to 1.39 has a gain of 2.31 as compared with 1.56 for a vertical half-wave antenna. The other example of a horizontally radiating array consists of a single ring of short antennæ. An example of this type is calculated which has a gain of 2.0 with a total of 23 antennas placed in a circle with a radius of 1.43. These figures are not given as the best that can be done, but only as examples.

REVIEW.

AIRCRAFT RADIO.

By D. Hay Surgeoner. Pitman's. 1938. 12/6.

Many books have been published which deal with the design and construction of radio transmitters and receivers. It is rare to find a book dealing with the operation of wireless sets.

Mr. Surgeoner's book is particularly welcome in view of the increasing importance of radio to air line operation, and of the great difficulty of obtaining the information elsewhere. This information is scattered through the "Air Pilot," "Notices to Airmen," "Admiralty List of Signals," and other books. There is still no book dealing completely with air wireless procedure, for Surgeoner does not give a full account of the "Q" Code. Perhaps a future edition will include this.

After dealing with radio networks, wave lengths and communication systems in a very satisfactory manner, the author goes on to describe directional and landing systems. It is here that we are particularly grateful for the first clear and accurate account of this important subject. The Lorenz blind landing system is illustrated by the Heston approach of QDM 273°, which was the first to be installed in this country.

There follows an interesting and well illustrated account of the wireless equipment of aircraft. The pilot will be particularly interested in pages 86-91, dealing with direction finding and homing from the air.

The book is completed by a chapter on airport wireless equipment, again very well illustrated. The last chapter deals with airport and airway illumination. It is well written, but seems singularly out of place. The only excuse seems that these aerial lighthouses come under the general category of "beacons."

The book can, however, be thoroughly recommended as the only one of its kind dealing with wireless operation in the air.