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(Prepared by R.T.P.)

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Corner Losses in Ducts. Factors Affecting the Design of Efficient Corners and Leading to a Reduction in Resistance. (G. N. Patterson, Airc. Eng., Vol. 9, August, 1937, pp. 205-208.) (50/1 Great Britain.)

If h = height of duct;
d = width of duct;
r = mean radius of curvature;
Δp = loss of static pressure at corner;
q = dynamic head;
the following values for $\Delta p/q$ are obtained for a 90° turn and various values of h/d and r/d.

h/d	r/d	$\Delta p/q$
1	0.5	2
1	1.0	0.4
1	2.0	0.2
2	1.0	0.3
4	1.0	0.2

Thus, by choosing large values of r/d and h/d, the pressure drop can be very considerably reduced. By fixing guide vanes in the corners, the value of $\Delta p/q$ can be further diminished to 0.13.

Particulars of the optimum shape and spacing of such guide vanes are given.

On the Streaming of Water from Underneath a Sharp-Edged Sluice. (G. Pajer, Z.A.M.M., Vol. 17, No. 5, October, 1937, pp. 259-69.) (50/2 Germany.)

As this problem, because of the acceleration due to gravity, cannot be solved by the ordinary method of conformal representation, the author introduces in its stead another problem solvable by this method; he supposes, in fact, that in the plane of the reciprocal complex velocities the curve corresponding to the water surface down-stream from the sluice is the quadrant of an ellipse. Having solved this problem, he justifies his method by showing that the calculated water surface satisfies the relation $w = \sqrt{\{2g(h-y)\}}$ with all desirable accuracy.

On the Formula for the Velocity Distribution near Walls. (A. Izakson, Technical Physics of the U.S.S.R., Vol. 4, No. 2, 1937, pp. 155-62. In English.) (50/3 U.S.S.R.)

It is shown that the law of the distribution of the mean velocities in a turbulent flow near the laminar layer may be obtained independently of Kármán's differential equation and Prandtl's hypotheses concerning the " Mischungsweg."

Is Turbulent Motion Possible in an Incompressible Fluid Without Forming Surfaces of Discontinuity? (A. Izakson, Technical Physics of the U.S.S.R., Vol. 4, No. 3, 1937, pp. 239-40. In English.) (50/4 U.S.S.R.)

The present paper studies a particular case of the motion of an incompressible fluid, viz., steady turbulent motion in a straight circular pipe of infinite length. Such a choice of motion enables us to introduce certain symmetry conditions into the mean motion.

The author demonstrates that the differential equations, obtained by the method of Friedmann and Keller (on the hypothesis of the continuity of the first space derivatives of the velocity components) are not compatible with the hypotheses of symmetry.

Assuming that the latter hypotheses are satisfied, it becomes necessary to reject the hypothesis of continuity; the author supposes that this corresponds most closely to the actual state of affairs.

It is essential to note, that all the deductions have been made solely on the basis of the differential equation of continuity.

This avoids the necessity of making a series of additional hypotheses.

The Effect of Ground on the Aerodynamic Characteristics of a Monoplane Wing. (I. Tani, M. Taima and S. Simidu, Aer. Res. Inst., Tokio, Report No. 156, Sept., 1937.) (50/5 Japan.)

The present paper deals with the effect of ground on the aerodynamic characteristics of a monoplane wing. In the first part of the paper theoretical calculations are worked out, taking into account the finite dimensions of the chord and the thickness of the wing. The results of these calculations are then reduced to a simple form, readily applicable in practice. The second part of the paper contains the results of wing model experiments carried out at the Aeronautical Research Institute. For moderate values of lift coefficient, the calculated effects of ground agree very well with the results from experiment. The maximum lift is somewhat reduced when the distance of the wing above the ground is of moderate value, while it is increased when the distance becomes unusually small.

The Flow Resistance of Compressible Gases in Smooth Round Tubes of Constant Radius. (V. Lelchuk, Technical Physics of the U.S.S.R., Vol. 4, No. 8, 1937, pp. 592-621. In German.) (50/6 U.S.S.R.)

The experiments were carried out with superheated steam under conditions of no heat loss. The velocity varied from 280 to 600 m./sec. and the Reynolds number ranged from 250,000 to 800,000. The resistance coefficient was found to be independent of the ratio of the flow velocity to that of sound, but varied with Reynolds number in a similar manner to that found by Nikuradse for incompressible fluids.

The Effect of the Viscosity of Liquid upon the Laws of Turbulent Flow in a Straight Cylindrical Pipe with Smooth Walls. (G. A. Gurjenko, Technical Physics of the U.S.S.R., Vol. 4, No. 8, 1937, p. 664. In English.) (C.A.H.I., No. 303, p. 56, Institute Edition, Moscow, 1936.) (50/7 U.S.S.R.)

As the basis of his analysis the author takes the system of equations for turbulent transfer proposed by Gvido Mattioli. The main advantage of Mattioli's equations consists in the fact that they form a closed system of differential equations (equations for the transfer of the momentum and the transfer of the angular momentum).

The author's purpose was to replace G. Mattioli's boundary conditions by new boundary conditions, corresponding to the modern physical concept of turbulent flow and the existence of a laminar sub-layer.

Outside this layer the author admits the existence of a region where viscous and turbulent friction act simultaneously.

As a result of the author's modernisation of Mattioli's theory he was able to derive a new resistance formula, which represents a generalisation of the well-known formula of T. Kármán. The author's formula is in excellent agreement with the experimental data (I. Nikuradse), for almost the entire interval of Reynolds numbers investigated up to date ($Re \leq 3.24 \times 10^6$), whilst Kármán's formula holds only for large values of Reynolds number.

Velocity profiles obtained by the author using the method of graphical integration are also in satisfactory agreement with experiments at small Reynolds numbers.

Review of the Modern Semi-Empirical Theories of Turbulence. (V. V. Voishel, Technical Physics of the U.S.S.R., Vol. 4, No. 8, 1937, p. 665. In English.) (50/8 U.S.S.R.)

The author begins with a comparison between the laminar and the turbulent flow. Next, in logical succession, but very briefly, the author states the theories of Reynolds-Bussinesque, L. Prandtl and G. I. Taylor. More space is given to T. Kármán's theory of mechanical similarity. The text contains not only the results of Kármán's investigations and Nikuradse's experiments, but also critical notes made by L. Loiziansky about these investigations. A brief description of the investigations made by Koroku Wada and by the author himself are also included.

The last three chapters are devoted to G. Mattioli's theory of turbulence which the author discusses in great detail, since this theory has not yet received the attention that is due to it among specialists.

The Air Drag of Hulls. (L. P. Coombes and K. W. Clark, Airc. Eng., Vol. 9, No. 106, Dec., 1937, pp. 315-21 and 328.) (50/9 Great Britain.)

The drag of a normal hull of good form is about 30 to 40 per cent. greater than the drag of a pure streamline shape of the same volume, and this is increased a further 20 to 25 per cent. by the need for lateral stabilisation. It is possible to reduce the hull plus stabiliser drag to some 15 per cent. above the ideal, but the actual figure will, in general, be higher owing to seaworthiness requirements.

Theoretical and Experimental Basis for Research and Development of Undercarriage Springs. (F. Michael, L.F.F., Vol. 14, No. 8, 20/8/37, pp. 387-416.) (50/10 Germany.)

As indicated by the title, this most comprehensive report attempts to put on a scientific basis the whole question of undercarriage springing. After defining the various terms which enter into a proper understanding of the loading and unloading characteristic of an undercarriage, various types of idealised loading are investigated mathematically and graphically. The author concludes with a description of static and dynamic tests carried out on a complete half of the undercarriage or on certain parts thereof. By laying down test schedules of this kind, it is hoped to obtain conformity in the results of different research institutions.

Résumé and Analysis of N.A.C.A. Lateral Control Research. (F. E. Weick and R. T. Jones, N.A.C.A. Report No. 605, 1937.) (50/11 U.S.A.)

An analysis of the principal results of recent N.A.C.A. lateral control research is made by utilising the experience and progress gained during the course of the investigation. Two things are considered of primary importance in judging the effectiveness of different control devices. The (calculated) banking and yawing motion of a typical small aeroplane caused by a deflection of the control,

and the stick force required to produce this deflection. The report includes a table in which a number of different lateral control devices are compared on these bases.

Test flights demonstrated that satisfactory lateral control at high angles of attack depends as much on the retention of stability as on aileron effectiveness.

The stick force of plain ailerons can be effectively reduced by the use of a differential linkage in conjunction with a small fixed tab arranged to press the ailerons upward.

New Records by the F.W. 61 Helicopter. (Flugsport, Vol. 29, No. 23, 10/11/37, pp. 644-5.) (50/12 Germany.)

The following performance was obtained by Miss H. Reitsch:—

Height = 2,439 m.
Speed = 122.6 km./hour.
Distance = 108 km.

The handling of the helicopter is described as follows:—

Vertical ascent.—Engine full throttle—large incidence of rotor blades.
Hovering.—Engine slightly throttled.
Descent.—Engine throttled further.
Flat turn.—Differential incidence of rotor blades so that torque reaction is not completely balanced. A rotation about vertical axis of aircraft results.
Lateral control.—Differential incidence of rotor blades so that an excess lift is produced by one or other of the rotors.
Curve in horizontal flight.—Same as above, aided by rudder.
Horizontal flight (forward).—Tail of machine lifted by action of elevator.
Horizontal flight (backward).—Tail depressed.

If the engine fails, the rotor wing incidence is changed automatically so that autorotation takes place without change in direction of rotation of rotor. It is claimed that this is the first time that a helicopter has been landed under these conditions.

Safety in gusts.—This is assured by a universal joint at the rotor blade root. Such a device had already been proposed by Renard in 1904 and has also been adopted by Cierva.

German Air Speed Record. (Les Ailes, No. 857, 18/11/37, p. 3.) (50/13 Germany.)

The speed record (611 km./hour) was obtained on a base of 3 km. which was flown six times in each sense at an altitude of 35 m. The aircraft was the Me. 113R which is stated to be a development of the well-known fighter Me. 109. An electrically controlled V.P. propeller, type "Heddernheimer Kupferwerke," was used. The engine, DB. 600, is normally rated at 1,000 b.h.p. at 4,000 m. The author suggests that for these records, the engine was boosted to something of the order of 1,500 b.h.p., which appears feasible since the whole flight only lasted 20 minutes.

On the Dynamics of Symmetrical Flight of an Aeroplane. (E. Ikonnikov, Technical Physics of the U.S.S.R., Vol. 4, No. 6, 1937, pp. 433-47. In English.) (50/14 U.S.S.R.)

The method of Poincaré is applied in this note to establish a qualitative picture of possible motions of an aeroplane in a vertical plane at a constant angle of incidence and with engine off.

The problem of qualitative investigation of the motion of an aeroplane in a vertical plane at a constant angle of incidence was considered in the general case (the engine working) by Alayrac. However, his paper does not contain

a strict and exhaustive study both of the general case and of the elementary problem which concerns us. A strict solution even of this elementary problem appears therefore to present some interest, the more so since the solution can be carried out in an exceedingly simple manner, provided it is first proved, with the aid of Bendixson's criterion, that there are no closed phase trajectories.

The questions treated in separate paragraphs of this note are as follows:—

(1) Reduction of the equations of motion to a form convenient for investigation.

(2) Investigation of the equations of motion. Qualitative picture of phase trajectories in the presence of drag.

(3) Qualitative picture of phase trajectories in the absence of drag.

Pressure Distribution Measurements at Large Angles of Pitch on Fins of Different Span-Chord Ratio on a 1/40 Scale Model of the U.S. Airship "Akron." (J. G. McHugh, N.A.C.A. Report No. 604, 1937.) (50/15 U.S.A.)

Pressure distribution measurements on a 1/40 scale model of the U.S. airship "Akron" were conducted in the N.A.C.A. 20-foot wind tunnel.

The measurements were made on the starboard fin of each of four sets of horizontal tail surfaces, all of approximately the same area but differing in span-chord ratio, for five angles of pitch varying from 11.6° to 34°, for four elevator angles, and at air speeds varying from 56 to 77 m.p.h. Pressures were also measured at 13 stations along the rear half of the port side of the hull at one elevator setting for the same five angles of pitch and at an air speed of approximately 91 m.p.h.

The normal force on the fin and the moment of forces about the fin root were determined. The results indicate that, ignoring the effect on drag, it would be advantageous from structural considerations to use a fin of lower span-chord ratio than that used on the "Akron."

Spinning Characteristics of the XN2Y-1 Airplane Obtained from the Spinning Balance and Compared with Results from the Spinning Tunnel and from Flight Tests. (M. J. Bamber and R. O. House, N.A.C.A. Report No. 607, 1937.) (50/16 U.S.A.)

A 1/10 scale model of the XN2Y-1 aeroplane was tested in the N.A.C.A. five-foot vertical wind tunnel and the six components of the forces and moments were measured. The model was tested in 17 attitudes in which the full-scale aeroplane had been observed to spin, in order to determine the effects of scale, tunnel, and interference. In addition, a series of tests were made to cover the range of angles of attack, angles of sideslip, rates of rotation and control settings likely to be encountered by a spinning aeroplane. The data were used to estimate the probable attitudes in steady spins of an aeroplane in flight and of a model in the free-spinning tunnel.

The estimated attitudes of steady spin were compared with attitudes measured in flight and in the spinning tunnel. The results indicate that corrections for certain scale and tunnel effects are necessary to estimate full-scale spinning attitudes from model results.

Wind Tunnel and Flight Tests of Slot-Lip Ailerons. (J. A. Shortal, N.A.C.A. Report No. 602, 1937.) (50/17 U.S.A.)

The slot-lip ailerons developed by the N.A.C.A. consist of a flap-type spoiler with an adjoining continuously open slot. The ailerons were developed in an investigation of the delayed response, or lag, of spoiler-type lateral controls. Tests of these slot-lip ailerons were made on wing models in the seven by ten-foot

wind tunnel, on a Fairchild *22* aeroplane in the full-scale wind tunnel and in flight, and on the Weick W1-A aeroplane in flight.

In spite of some disadvantages, the N.A.C.A. slot-lip ailerons exhibited certain characteristics that are desirable for aeroplanes in which safety and simplicity of operation are considered of greater importance than high performance and a great degree of manœuvrability. The slot-lip ailerons permit the use of a full span flap; the slot may extend the angle of attack range with stability in roll; and the ratios of yawing moment to rolling moment are such as to be particularly satisfactory for the two-control operation of an aeroplane.

Flight Tests of an Aeroplane Showing Dependence of the Maximum Lift Coefficient on the Test Conditions. (H. A. Soule and J. A. Hootman, N.A.C.A. Tech. Note No. 622, November, 1937.) (50/18 U.S.A.)

Data are presented to show the extent to which the maximum lift coefficient and, consequently, the minimum speed of an aeroplane, as determined by flight tests, may vary with test conditions. The data show that $C_{L\max}$ may vary by as much as 14 per cent., depending on the altitude and wing loading at which the tests are made, the position or motion of the propeller, and the rate at which the angle of attack is changing when the maximum lift coefficient is obtained. The variation of the maximum lift coefficient with these factors, which are under the control of the test engineer, shows the need of standardising the test procedure. A further variation is shown with wing conditions as affected by weathering and vibration, factors that cannot be completely controlled.

New Developments in Hot Air Balloons. (D. Hildebrandt, Luftwelt, Vol. 2, No. 12, December, 1935, pp. 510-512.) (50/19 Germany.)

Experiments with the Brunner hot air balloon were carried out by the D.V.L. in 1934. This balloon had a capacity of 1,600 m.^{3} and was intended for one passenger. The burner was operated by a mixture of paraffin and steam and smokeless combustion was obtained with flames up to 2 m. long.

The experiments have been continued at Vienna, by Messrs. Marek and Emmer and the author describes a short flight at which he assisted (four passengers were carried, the balloon capacity being 1,800 m.^{3}). With the advent of liquid propane, the burner question becomes much simplified and further experiments with hot air balloons using this fuel are in progress in Germany.

As apart from first cost, the running expenses are very small, the author considers this form of ballooning as a promising new form of sport.

Bofors Rapid Fire 40 mm. Anti-Aircraft Gun. (U.S. Naval Institute Proceedings, Vol. 63, No. 417, Nov., 1937, p. 1666.) (50/20 Sweden.)

The gun fires 120 shots a minute, the muzzle velocity being 3,060 feet/sec. It has a very straight trajectory and at a height of 6,100 feet the deviation from the line of sight is only 6.8 feet. The weight of the shell is approximately 2.2lb. and a single hit is stated to be sufficient to destroy a plane.

It is calculated that an aircraft diving from 6,800 to 3,400 feet at an average speed of 500 feet/sec. will only have one chance in 120 of getting down to the lower altitude without being hit.

Aircraft and Chemical Warfare. (P. J. de Brockert, Chemisch Weekblad, Vol. 34, No. 4, 1/1/1937, pp. 66-68.) (50/21 Holland.)

On account of its relatively flimsy casing, a gas bomb can hold up to 50 per cent. of its total weight in the form of chemicals, whilst the artillery gas shell only contains 8 per cent. Moreover, the shell will waste most of its content

impregnating the ground, and it is reckoned that only 5 per cent. of the charge will contaminate the air at some distance. On the other hand, a Yperite (mustard gas) bomb weighing 4.6 kg. will infect a surface of approximately 160 m.^{2}. Even under these more favourable conditions, however, it is stated that it will require nine aircraft dropping each 16 bombs of this type at intervals of 25 m. in order to infect a surface of 200×350 m.^{2}, the contamination being 6 gm. of chemical per m.^{2}.

As this concentration is the maximum required for effective results, it is quite clear that an extended target like a town would require an impossible number of aircraft, if the attack is carried out by gas alone. The attacker will probably rely most on incendiary bombs to start fires and hamper the fire fighting with delay explosion bombs. A certain amount of gas will be used, but mainly for its psychological effect.

Materials for Artificial Fogs. (C. W. v Hoogstraten, Chemisch Weekblad, Vol. 34, No. 4, 23/1/1937, pp. 55-6.) (50/22 Holland.)

Generally speaking, the light absorption produced by a fog is a maximum if the particle size is of the order of the wave length of light ($4-7.5 \times 10^5$ cm.). Particles of this size are generally obtained by the condensation of atmospheric moisture and all the effective fog producing chemicals such as phosphorus SO_3, and metal chlorides of Ti, Si, Sn, and Zn are for this reason very hygroscopic. Two zinc compounds have lately come into the market under the trade names " Berger Mixture " and " Hexiet." The former consists mainly of a mixture of $CC2_4$ and Zn, whilst the latter is composed of equal parts of Zn and hexachlorethane.

Ballistic Characteristics of Aircraft Bombs. (G. Otten, De Ingenieur in Nederlandsch-Indie, No. 12, 1936, pp. 179-185.) (50/23 Holland.)

On the assumption that the bomb behaves as a particle and that the resistance is of the type $R = K\rho V^2$, the author obtains expressions for the following :—

(*a*) Impact velocity and range if height and time of drop is known.

(*b*) Variation of terminal velocity with height, for the density distribution existing in the Netherland-Indies.

(*c*) Calculation of time of drop from a given height if the time for another height is known.

(*d*) Calculation of impact velocity under dive bombing conditions if the time of drop from a different height with horizontal release is known.

The author in the main follows the lines of R. and M. 1121, but the graphical representation as well as the extension to dive bombing conditions is of interest.

It appears that a bomb released horizontally at 4,000 m. (speed of aircraft 50 m./sec.) will have an impact velocity of 245 m./sec., whilst the same bomb released vertically at an altitude of 2,000 m. whilst diving at 150 m./sec. will have an impact velocity of 223 m./sec.

Aerial Attack on a Large Town. (P. Etienne, Rev. de l'Arm. de l'Air, No. 99, Oct., 1937, pp. 1135-40.) (50/24 France.)

In order to assure evacuation and revictualling, the author considers it essential that the town be surrounded by a system of railways at an average distance of 20 km. from the densely populated region. The latter is connected to the circular railway system by a number of one-way radiating roads which are reserved for in and outward traffic. The scheme is illustrated in the case of Paris and reference is made to a similar plan being considered for the town of Brussels.

What We Have Learnt so Far from the Spanish Civil War. (La Science et la Vie, No. 245, Nov., 1937, pp. 382-3.) (50/25 France.)

1. A sufficient number of single-seater fighters can prevent heavy bombers from approaching a target.

2. Heavy bombers (of the " Flying Fortress " type of Douhet) have not justified their existence.

3. Light bombers of good manœuvrability and suitable for ground attack have played an important rôle in co-operation with land forces.

4. The aircraft used on both sides does not represent, by any means, the most up-to-date material. Thus practically no cannon aircraft is used, although it is known that the Germans have lately perfected a new 23 mm. cannon (Messerschmitt).

5. What can be done by modern bombers if unopposed by fighting aircraft is shown by the recent Japanese attacks on Chinese towns.

The Design of Aero-Engine Superchargers. (W. von der Null, L.F.F., Vol. 14, No. 4-5, 20/4/1937, pp. 244-253.) (50/26 Germany.)

The author concludes that the following approximate circumferential speeds are required for a single stage centrifugal blower in order to reproduce ground level pressure at various altitudes:—

Altitude (feet).	Circumferential Speed (feet/sec.).
10,000	800
20,000	1,150
30,000*	1,400

* Intercooler required.

At altitudes up to 25,000 feet, overall adiabatic efficiencies of the order of 70 per cent. should be possible. (ηad = calculated adiabatic work of compression/work supplied to blower shaft.)

The efficiency is very markedly affected by leakage and this accounts for the success of the shrouded type of rotor, since with this design casing clearance difficulties are reduced. The importance of suitable blade shape at entry and proper diffusor blading design is illustrated by experiments and a semi-empirical formula for the effect of the number of rotor blades is given.

(Available as Translation No. 517.)

Energy Loss Velocity Distribution, and Temperature Distribution for a Baffled Cylinder Head. (M. J. Brevoort, N.A.C.A. Tech. Note No. 620, Oct., 1937.) (50/27 U.S.A.)

A study has been made of the important principles involved in the operation of a baffle for an engine cylinder and shows that the cooling can be improved 20 per cent. by using a correctly designed baffle. Such a gain is as effective in cooling the cylinder with the improved baffle as a 65 per cent. increase in pressure drop across the standard baffle, which had a $\frac{1}{4}$-inch clearance between baffle and fin tips.

Electrical Character of the Spark Discharge of Automotive Ignition Systems. (M. F. Peters, G. F. Blackburn and P. T. Hannen, Bur. Stan. J. Res., Vol. 19, No. 4, Oct., 1937, pp. 401-21.) (50/28 U.S.A.)

Two methods suitable for measuring the current in the discharge with the cathode ray oscillograph are (1) measurement of the voltage across a known inductance, and (2) deflection of the cathode beam by the magnetic field set up by the current. The paper deals in detail with the application of these two

methods, including, in the first method, the equations by which the current is derived, and the method of calibrating the measuring circuit in both methods.

An analysis is made of oscillograms obtained by both methods for the discharge in the calibrating circuits and in a typical ignition circuit. Crest currents of 50 to 80 amp. were measured. The frequencies ranged from 6 to 10 mc./s., the decrements from 0.08 to 0.40 and the energy expended from 0.0023 to 0.0135 j. The expended energy is found to agree with the energy known to be stored in the capacitance of the circuit at the beginning of the discharge.

Journal-Bearing Design as Related to Maximum Loads, Speeds and Operating Temperatures. (S. A. McKee, Bur. Stan. J. Res., Vol. 19, No. 4, Oct., 1937, pp. 457-65.) (50/29 U.S.A.)

Equations are derived for the rate of heat generation and for the rate of heat dissipation in terms of factors of construction and operation. Equating the rates of heat generation and dissipation yields an approximate relation between the construction and operation factors and the rise in temperature of a bearing above its surroundings when operating in the region of stable lubrication. The product of the maximum allowable pressures and speeds at which a bearing will operate under the conditions prescribed for safety is obtained by substituting in the above relation permissible values for the temperature rise and the generalised operating variable ZN/P, where Z is the viscosity of the oil, N the speed of the journal, and P the bearing pressure.

In a numerical example to illustrate the application of the method, individual values for the maximum permissible pressure and speed for a given bearing when using a given lubricant are obtained from the equation for the product of the speed and pressure and the minimum permissible value of ZN/P for stable lubrication.

Pressure Drop Across Finned Cylinders Enclosed in a Jacket. (V. G. Rollin and H. H. Ellerbrock, N.A.C.A. Tech. Note No. 621, Nov., 1937.) (50/30 U.S.A.)

The pressure drop across finned cylinders enclosed in a jacket for a range of air speeds from approximately 13 to 230 m.p.h. has been investigated. Tests were made to determine the effect on the pressure drop of changes in fin space, fin width, jacket entrance and exit areas, skirt-approach radius, and the use of fillets and a separator plate at the rear of the cylinder.

The pressure drop across the cylinder increased as the fin space decreased, the increase being very rapid at fin spaces smaller than approximately 0.20 inch. Fin width had little effect on the pressure drop for the range of widths tested. The pressure drop across the cylinder was nearly halved by increasing the skirt-approach radius from $\frac{3}{4}$ inch to $1\frac{1}{4}$ inches, but fillets and a separator plate at the rear of the cylinder had little effect on pressure drop. The pressure drop across a cylinder with tapered fins was greater than that for a cylinder having rectangular fins with the same effective fin spacing.

Hydraulic Phenomena in Fuel Injection Systems for Diesel Engines. (K. J. De Juhasz, Trans. A.S.M.E., Vol. 59, No. 8, Nov., 1937, pp. 669-77.) (50/31 U.S.A.)

The author compares the problems of water-hammer phenomena with those of fuel injection surges. He also presents a graphical method for analysing the pressure and velocity conditions and shows how it is applied to representative examples of injection systems with a timed valve, and those with a timed pump. In the latter group the action of " open " and " closed " nozzles is explained. Singular cases of injection conditions are analysed. The effect of enclosed volume and of included rigid masses is examined. Various methods of terminating the injection are discussed.

Endurance and Fuel Consumption. (H. Constant, Airc. Eng., Vol. 9, No. 106, Dec., 1937, p. 329.) (50/32 Great Britain.)

The total specific weight S of a power plant in lb./b.h.p. is expressed as

$$S = \{ W + fP_cR/V \} / P_t$$

where W = weight of power plant;
f = specific fuel consumption in lb./b.h.p. hour;
P_c = cruising b.h.p.;
R = range;
V = cruising speed;
P_t = take-off power;

assuming

$$P_c/P_t = \tfrac{1}{2}$$
$$S = W/P_t + \tfrac{1}{2} fR/V.$$

If the compression ratio is lowered, the permissible boost increases and W/P_t decreases.

On the other hand, f increases. The importance of the term containing f will, however, diminish for a given R as V increases. The author shows that with R fixed at 800 miles and $V = 100$ m.p.h., S remains practically constant for all compression ratios, the decrease in the power plant weight just balancing the increase in fuel consumption. At higher air speeds, however, the balance is in favour of the boosted low compression engine, the saving in total weight (engine and fuel) for a 2,000 b.h.p. installation being about 760lb. at 300 m.p.h. The benefit will obviously diminish if longer ranges (or endurance) are considered.

The Pescara Free Piston Compressor. (J. Marival, La Science et la Vie, No. 246, Dec., 1937, pp. 466-469.) (50/33 France.)

This is a form of the Junkers opposed piston engine in which the pistons are not returned by positive action of a crankshaft but entirely by the expansion of air previously compressed during the firing stroke. In order to assure perfect synchronisation, the two pistons are however connected by an oscillating linkage. As the negative work of the Diesel is very much less than the expansion work, only a small quantity of air need be trapped to ensure the oscillation of the system. The rest of the available work is transformed into compressing and delivering air. Compressors of this type have already received extensive application in industry and it is claimed that over 25 per cent. of the heat of combustion of the fuel reappears as adiabatic work of compression in the air delivered. (Fuel consumption 176 gm. per air h.p.) This type of compressor appears specially suited for pneumatic power transmission (locomotives) and its possibilities in aircraft were investigated by the late Prof. Junkers, who has developed a similar type of machine.

Combustion Levels in Flame Gases. (W. T. David, Engineering, No. 3748, 12/11/1937, pp. 531-533.) (50/34 Great Britain.)

There exists a long lived latent energy in flame gases which is probably associated with the presence of metastable molecules in the flame front. As a result the actual temperature reached in the flame is much lower than the calculated temperature after allowance for heat loss.

The author proposes the term " combustion level " for the ratio of energy accounted for in the flame (on the assumption that the gases are normal) to the heat of combustion of the original fuel mixture.

The " combustion level " can be raised by increasing the density of the burning charge. The author has investigated closed vessel explosion for a number of gases, obtaining values ranging from 72 to 99 per cent. for the combustion level.

The Properties and Testing of Lubricants—Review of Papers Presented to the Inst. Mech. Eng., Oct., 1937. (H. J. Gough, Engineering, No. 3748, 12/11/1937, pp. 553-555.) (50/35 Great Britain.)

The papers presented afford evidence of the great attention now being given to lubrication research. Unfortunately in certain fields, such as internal combustion engine lubrication, laboratory tests are still unsatisfactory.

The large oil producers have little confidence in oxidation tests and are almost entirely guided by full-scale results obtained on representative engines. There is urgent need for co-operation and pooling of results. Most of the work carried out in individual laboratories cannot be checked since the lubricants used cannot be specified closely enough. The need for a common stock of basic lubricants which could be made available to investigators is clearly indicated.

On the Theory of Bunsen Flames. (L. Khitrin, Technical Physics of the U.S.S.R., Vol. 4, No. 2, 1937, pp. 121-37. In English.) (50/36 U.S.S.R.)

1. It is shown that the form of the internal cone of a bunsen flame may be theoretically explained in a considerably more simple manner, and with greater physical reality, than was done by Michelson. The resulting expression for the equation of the surface of ignition, may be written in the form :—

$$z = a\,(R - r) - b\,(R^3 - r^3)$$

where a and b are constants depending on the dimensions of the burner and on the rate of gas flow.

2. According to the theory advanced, the really steady part of the ignition surface is the lower ring part of the cone, where direct compensation of the flame speed by the opposing movement of the gas occurs. This steadiness of the ring zone plays the part of a continuously acting ring of ignition, and plays a very essential rôle from the practical point of view.

3. The equations deduced for the form of the ignition surface allow of a simple and relatively accurate calculation of the height of the bunsen cone, and the dimensions of its lateral surface.

The Spray Range of Liquid Fuel in an Opposing Air Flow. (In English.) (L. Strazhevsky, Technical Physics of the U.S.S.R., Vol. 4, No. 6, 1937, pp. 438-47.) (50/37 U.S.S.R.)

Research work was carried out to determine the range of a spray of liquid fuel under working conditions of an internal combustion engine with fuel injection in the inlet manifold.

The work gave the following results :—

(1) The range of penetration of drops of fuel depends directly on the injection pressure. However, as the injection pressure is increased, the influence of the pressure on the distance of penetration decreases.

(2) The distance of penetration varies inversely as the speed of the opposing air flow.

(3) The experimentally determined mean value of the coefficient of air resistance is

$$\psi = 0.093.$$

A Study of Di-isopropyl Ether as a Motor Fuel. (A. Sokolik and A. Voinov, Technical Physics of the U.S.S.R., Vol. 4, No. 8, 1937, pp. 638-660. In English.) (50/38 U.S.S.R.)

Isopropyl ether as a fuel has an abnormal speed effect, *i.e.*, the knocking tendency increases with r.p.m. It is suggested that with this fuel the unstable oxidation products (which are commonly held to be responsible for subsequent detonation) are formed too soon after ignition and will decompose without being able to accelerate the main reaction. An increase in speed of engine operation will lessen the time interval between inflammation and maximum concentration

of unstable products and thus promote detonation. The authors have carried out an interesting series of experiments on various fuel mixtures at various temperatures and speeds on the C.F.R. engine. It appears that the relative knock rating of fuels can be profoundly changed by alteration of speed and temperature during the tests. For this reason it is suggested that comparison should be carried out at a series of values of the variables, so as to approximate more closely to full-scale conditions.

Making Castor Oil Soluble in Mineral Oil. (Hungarian Patent No. 116,570.) (Ind. and Eng. Chem. (News Edn.), Vol. 15, No. 22, 20/11/37, p. 495.) (50/39 Hungary.)

According to a Hungarian patent, No. 116,570, the castor oil is made soluble by mixing it with potassium bicarbonate and heating the mixture in vacuum to 230°-280°C. The product will mix with mineral oils in all proportions.

The Determination of the Ignitability of Diesel Oils on a Laboratory Scale. (R. Heinze and M. Marder, J. Inst. Petrol. Tech., Vol. 23, No. 168, Oct., 1937, pp. 603-15.) (50/40 Great Britain.)

In several recently published articles, the reliability of the laboratory methods for determining the ignitability of Diesel oils has been questioned. In spite of these efforts it has been proved by the present report that, by the proper application of the density method developed by the authors cetene values in good agreement with those determined by engine tests are obtained. Standard as well as sub-standard testing oils, and also Diesel oils of any origin (as for instance from crudes, lignite tar, coal tar or those manufactured by hydrogenation, by synthesis or by extraction), when tested by the density method, yielded within very narrow limits the same cetene values as determined by engine test with the aid of the C.F.R. motor.

New Aircraft Research Apparatus Utilising the Scratch Method. (H. Freise, L.F.F., Vol. 14, No. 8, 20/8/37, pp. 273-286.) (50/41 Germany.)

The behaviour of an aircraft structure in flight involves the measurement of small displacements. These measurements are rendered difficult by the onerous condition existing in flight, but the scratch method (by means of which the displacement is recorded directly by means of a stylus on a hard surface and subsequently magnified) has proved successful by its simplicity, robustness, freedom from lag, and high accuracy.

The article describes a variety of applications of the method as developed by the D.V.L. to such instruments as extensometers, accelerometers, dynamic head recorders, parachute shock recorders, etc. Lately the method has also been applied to cases where records are required over relatively long intervals of time. As an example an engine revolution counter is described which gives the r.p.m. to within ± 5 over a time interval of 80 minutes. A further interesting application is the recording of aircraft wing vibrations in flight. In both cases the record is obtained on a continuous film which is driven by a light synchronous electric motor.

Electrical Thermometers for Aircraft. (J. B. Peterson and S. H. J. Womack, N.A.C.A. Report, No. 606, 1937.) (50/42 U.S.A.)

Electrical thermometers commonly used on aircraft are the thermo-electric type for measuring engine cylinder temperatures, the resistance type for measuring air temperatures, and the superheat meters of the thermo-electric and resistance types for use on airships. These instruments are described and their advantages and disadvantages enumerated. Methods of testing these instruments and the performance to be expected from each are discussed. The field testing of engine cylinder thermometers is treated in detail.

A High Speed Camera for Propeller Research. (E. L. Gayhart, Eng. Absts., No. 76, October, 1937, p. 8.) (50/43 Great Britain.)

The author describes the high speed camera developed at the experimental model basin at the U.S. Navy Yard, Washington, D.C., for studying cavitation phenomena in the variable pressure water tunnel. Its design was fixed by the single consideration that the time of exposure must be so brief that the tips of the propeller blade will not move more than one-hundredth of an inch during the exposure. With a speed of rotation of 1,400 r.p.m. for cavitating model propellers of 8in. average diameter, corresponding with a destroyer propeller running at about 350 r.p.m., this involved an exposure time of approximately 1/50,000 sec. This was obtained by means of a mechanical shutter designed as a revolving disk of 20in. external diameter having a radial slit 2in. long with its outer end at a radius of 19½in. The illumination problem was solved by the use of photographic flash lamps with a peak well in excess of 750,000 candle-power, reinforced by a reflector shaped as an ellipsoid of revolution placed with the centre of the lamp bulb at one focus of the ellipse and the propeller hub at the other focus. The author reproduces examples of cavitation photographs taken by means of this camera, which reveal the peculiar pattern made by the propeller tip vortices, the growth and motion of the bubbles on the back of the blade, and the bubble formation in the current beyond the propeller.

Precision Contents Gauges for Tanks Containing Liquids. (Die Messtechnik, April, 1933.) (Original of Paper in R.T.P. (Absts.).) (50/44 Germany.)

The gauge works on the well known pneumatic principle, the pressure required to force air through the depth of liquid in the tank being a measure of the height of liquid and therefore of the contents. The novelty consists in measuring the pneumatic pressure in terms of a column of the same liquid as is contained in the tank. For this purpose the gauge is in the form of a Fortin barometer, the lateral vessel of which is connected to the bottom of the tank by means of a vertical stand pipe whilst the top of the gauge glass of the barometer is connected with the top of the sealed fuel tank. A hand pump is suitably connected to the system for priming the " barometer " and ejecting air through the stand pipe.

It is stated that the gauge can be used on vehicles and on aircraft.

On the Notion of Resonance for Non-Linear Vibrations. (R. Iglish, Z.A.M.M., Vol. 17, No. 5, October, 1937, pp. 249-58.) (50/45 Germany.)

The notion of resonance for non-linear vibrations is established in strict analogy to the same notion for linear problems. The argumentation is based solely on Sturm-Liouville's methods for linear differential equations.

On the Tilting of a Grate System consisting of Two Spars Joined by Ribs. (J. Weinhold, Z.A.M.M., Vol. 17, No. 5, October, 1937, pp. 270-5.) (50/46 Germany.)

Supposing that the spars may be bent in the plane of the grate and twisted round their axes, and introducing some admissible simplifications, the author considers the cases when the spars are acted on by longitudinal pressure and bending moments in the plane of the grate. Under suitable boundary conditions he arrives at simple formulæ for the critical load.

On Some Plane Boundary Value Problems in Theory of Elasticity. (E. Weinel, Z.A.M.M., Vol. 17, No. 5, October, 1937, pp. 276-87.) (50/47 Germany.)

Using bi-polar co-ordinates the author calculates the stress in a plate with two circular holes and in a ring formed by two eccentric circles, with special reference to a plate with two holes subjected to uniform tension perpendicular to the straight line through the two centres.

Study of Transparent Plastics for Use on Aircraft. (B. M. Axilrod and G. M. Kilne, Bur. Stan. J. Res., Vol. 19, No. 4, Oct., 1937, pp. 367-400.) (50/48 U.S.A.)

Pending the results of further tests on samples of cellulose acetate, acrylate resin, and other plastics, which have been prepared by the manufacturers using modified compositions and methods of processing to overcome the defective behaviour noted during the course of this investigation, it is concluded that the problem of choosing between cellulose acetate and acrylate resin plastics for aircraft windows at present appears to be one of the required impact strength. If a relatively high impact strength is necessary, the cellulose acetate sheets are much superior to the acrylate resin in this respect. However, if high impact strength is not essential, then the superior clarity and weathering resistance of the acrylate resin makes it the more desirable material. Both the cellulose acetate and the acrylate resin have the advantages of being lighter in weight than glass and of being readily fitted to curved openings.

Graphical Computation of Stresses from Strain Data. (A. H. Stang and M. Greenspan, Bur. Stan. J. Res., Vol. 19, No. 4, Oct., 1937, pp. 437-41.) (50/49 U.S.A.)

The arithmetic involved in the use of the analytical solution for principal stresses in terms of strains on four intersecting gauge lines 45° apart is very tedious if these stresses are computed at many locations. This paper presents graphs which materially reduce the time and labour necessary for such computations. There are presented, also, graphs by means of which normal and shearing stresses on oblique planes are readily obtained from principal stresses. The use of the various graphs is illustrated by numerical examples.

Torsion Tests of Tubes. (A. H. Stang, W. Ramberg and G. Back, N.A.C.A. Report No. 601, 1937.) (50/50 U.S.A.)

Torsion tests of 63 chromium-molybdenum steel tubes and 102 17ST aluminium alloy tubes of various sizes and lengths were made to study the dependence of the torsional strength on both the dimensions of the tube and the physical properties of the tube material. Three types of failure were found to be important for sizes of tubes frequently used in aircraft construction: (1) Failure by plastic shear; (2) failure by elastic two-lobe buckling; (3) failure by a combination of (1) and (2), that is, by buckling taking place after some yielding of the tube material.

An adequate theory exists for explaining failure by (1) or (2). Most of the tubes failed by the combined failure (3), for which a theoretical solution seems unattainable at this time.

The Strength of Shell Bodies—Theory and Practice. (H. Ebner, L.F.F., Vol. 14, No. 3, 20/3/37, pp. 93-115. Translation in N.A.C.A. Tech. Memo. No. 838.) (50/51 Germany.)

The monocoque form of construction characterised by the fact that the skin is made as much as possible a stress-bearing member, has become increasingly popular, especially in the fuselages of the latest metal aeroplanes. It has introduced a number of new problems to the stress calculator and the designer.* The problems for the stress calculator fall into two groups: The determination of the stress condition (shell statics) and the determination of the failing strength (shell strength). A large part of these problems may, as a result of the research work of the last few years, be looked upon as being solved. The present report summarises the most important theoretical and experimental results on this sub-

* For a survey of these problems, see Luftwissen, December, 1935.

ject, special attention being given to the work done at the German Research Laboratory for Aeronautics (D.V.L.).

The Influence of Surface Plastic Deformations on the Impact Cold Brittleness of Steel. (F. Wittmank, Technical Physics of the U.S.S.R., Vol. 4, No. 3, 1937, pp. 224-37. In English.) (50/52 U.S.S.R.)

A description is given of experiments on the comparison of critical temperatures of brittleness for steel specimens; in one case the surface of the specimens being plastically deformed by means of a cutter, by rolling, and by a rain of steel balls (in a Herbert " Cloudbursts " apparatus); in the other case the specimens were turned in a lathe and either deeply etched or recrystallised. It is shown that the existence in the specimens of plastically deformed surface layers noticeably increased the cold brittleness to impact.

Mechanical Analysis of Impact Brittleness. (N. Davidenkov and F. Wittmann, Technical Physics of the U.S.S.R., Vol. 4, No. 4, 1937, pp. 308-24. In English.) (50/53 U.S.S.R.)

The critical temperature of brittleness of coarse-grained steel ($C = 0.24$ per cent.) found by impact tests of notched specimens, is 40° higher than that of fine-grained steel, whilst at the same time all their mechanical properties (except the elastic limit and the yield point) are practically identical.

This defect of coarse-grained steels may be due to:—

(*a*) The greater increase in its yield point in consequence of greater sensitivity to notching; or

(*b*) The greater increase in the yield point in consequence of greater sensitivity to high speeds; or

(*c*) The smaller value of the brittle strength.

The first of these suppositions was disproved by tests on unnotched specimens, when the difference not only did not disappear, but became even more marked. The second supposition must probably be rejected on the basis of the comparison of results of the same static tests at low temperatures, in which the different tendencies of steels to brittle fracture are completely maintained.

Thus, it is only possible that the third supposition is valid.

The Elasticity of Amorphous Bodies. (P. Kobeko, E. Kuvschinskij and G. Gurevich, Technical Physics of the U.S.S.R., Vol. 4, No. 8, 1937, pp. 622-37. In English.) (50/54 U.S.S.R.)

1. Reversible deformation may be considered as consisting of two components: Initial elastic or acoustic deformation and highly elastic deformation.

2. Total mechanical deformation of amorphous bodies is composed of three independent components: The elastic initial deformation, resilient highly elastic deformation and inelastic plastic deformation.

3. The initial modulus of shearing stresses in amorphous bodies is large. For phenol-phthalein, hard rubber and soft rubber it is equal to 2×10^4 kg./cm.^{2} and to 10^4 kg./cm.^{2} for resin.

4. The total modulus is many times less than the initial one. For soft rubber it is equal to 6 kg./cm.^{2}, for hard rubber—30 kg./cm.^{2}, for phenol-phthalein—2,500 kg./cm.^{2}.

Running-in Characteristics of Some White Metal Bearings. (S. A. McKee and T. R. McKee, Trans. A.S.M.E., Vol. 59, No. 8, Nov., 1937, pp. 721-4.) (50/55 U.S.A.)

This paper describes an extension of the investigation of the running-in characteristics of journal bearings which was a part of the programme of research on lubrication conducted at the National Bureau of Standards in co-operation

with the Special Research Committee on Lubrication of the American Society of Mechanical Engineers. The results of tests on three kinds of white metal bearings are given.

A four-bearing friction machine was used to determine the effect of progressive amounts of running-in, upon the frictional characteristics of the bearings. The results are compared with those of previous investigations and all are in agreement in providing an indication that the major effect of running-in is to reduce the friction losses at low values of ZN/P and to increase the permissible operating range. The results also give a comparison of the frictional and running-in characteristics of the various metals.

Ice Accretion on Aircraft—Notes for Pilots. (G. S. Simpson, Met. Office Prof. Notes No. 82, 1937.) (50/56 Great Britain.)

There are four main types of ice accretion:—

(*a*) A white semi-crystalline coating of ice which covers the surface of the aircraft (surface equivalent: hoar frost).

(*b*) A light white opaque deposit which accumulates on the leading edges of wings, struts and wires (surface equivalent: rime).

(*c*) A transparent or translucent coating of ice which has a glassy surface appearance (surface equivalent: intermediate between rime and glazed frost).

(*d*) A heavy coating of clear ice which may form all over the aircraft (surface equivalent: glazed frost).

Of the above (*a*) mainly affects windscreen and aerial and is not dangerous; (*b*) affects the aerodynamic characteristic of the wing, although the weight of ice deposited is relatively small; (*c*) and (*d*) affect the aircraft by the weight of deposit formed.

The author deals with the meteorological conditions likely to favour one or other of the above types. Before the meteorologist can issue an ice warning he must be certain that these conditions exist. The accretion varies so greatly in intensity and is of such a local nature that pilots cannot assume that they will meet with similar conditions in different parts of the same cloud layer nor even at the same place at some subsequent time.

For this reason the Meteorological Office has been very reluctant to undertake a regular issue of ice warnings. If warnings are issued on all occasions where accretion is possible, there would be so many failures that pilots would lose confidence in the value of the warnings.

Determination of the Size and Electrical Charge of Dust and Fog Particles. (N. Rosenblum, Technical Physics of the U.S.S.R., Vol. 4, No. 7, 1937, pp. 564-8. In English.) (50/57 U.S.S.R.)

The particles fall under gravity in a horizontal homogeneous alternating electrostatic field. The amplitude of the vibration of the particle is determined optically and the rate of descent is timed. After preliminary experiments had shown that the rate of drop was not affected by the amplitude of the vibration formulæ are deduced both for the size and charge on the particle.

The Mechanics of the Atmosphere. (J. Labadie, La Science et la Vie, No. 245, Nov., 1937, pp. 348-356.) (50/58 France.)

When a layer of liquid is heated from below a system of cellular vortices is formed which are known after the name of their discoverer as the Benard vortices. Similar considerations apply to circulation problems in the atmosphere and explain the formation of certain cloud patterns. Some of these clouds are, however, formed at high altitudes where it is difficult to account for their formation by purely thermal means (temperature gradient).

It has lately been shown, however, that an electric or ionisation gradient will act in a similar manner to a temperature gradient in producing vortex motions of the air, and since ionisation is very active at high altitudes, the formation of this particular cloud system can be satisfactorily accounted for.

The Dependence of the Coefficient of Thermal Conductivity of Gases and Vapours on the Pressure. (N. Vargaftik, Technical Physics of the U.S.S.R., Vol. 4, No. 5, 1937, pp. 341-60. In English.) (50/59 U.S.S.R.)

1. The hot wire method was applied to the determination of the thermal conductivity of gases and vapours in dependence on the pressure, tubes of very small diameter (less than 1 mm.) being used.

2. Measurements were made of the thermal conductivity of nitrogen up to 90 atmospheres and steam up to 30 atmospheres. It was shown that in these pressure regions no convective transmission of heat occurred in our experimental apparatus.

3. The dependence of the coefficients of thermal conductivity of nitrogen and steam on the pressure was determined.

4. A comparison was made between the experimental results for the thermal conductivity and those found from the relationship $\lambda = KC_v\eta$.

Complete Characteristics of Centrifugal Pumps and Their Use in the Prediction of Transient Behaviour. (R. T. Knapp, Trans. A.S.M.E., Vol. 59, No. 8, Nov., 1937, pp. 683-9.) (50/60 U.S.A.)

This paper describes the technique of determining the complete operating characteristics of a hydraulic machine such as a centrifugal pump or a turbine, together with a method of presenting these characteristics in a convenient manner on a single diagram. The characteristics of a modern, high head, high efficiency pump are analysed and presented in the manner proposed. The use of these complete characteristics for the prediction of the behaviour of the machine during operating transients is discussed and the analytical background is presented. The assumptions involved are investigated and experimental checks of their validity are offered. The inter-relationships between the hydraulic characteristics of the machine and the pipe line are indicated.

An Improved Medium Wave Adcock Direction Finder. (R. H. Barfield and R. A. Fereday, J. Inst. Elec. Engs., Vol. 81, No. 491, Nov., 1937, pp. 676-81.) (50/61 Great Britain.)

This paper describes a medium wave Adcock direction finder capable of working over the wave length range 750 to 2,000 metres (frequency 400 to 150 kc.) with a pick-up factor between 3 and 5 metres. Under favourable conditions a bearing can be taken on a field strength of 10 micro-volts per metre with a swing of less than 1°. When the field strength is 1 micro-volt per metre the corresponding swing is $\pm 10°$.

The standard wave error is less than 1° as measured on a wave length of 1,760 metres (frequency 170 kc.), and this may most probably be taken to be representative of its value over the whole range. The instrumental error after balancing is less than 1°, but no information is at present available as to how long the balance remains constant.

The instrument may therefore be said to constitute a practical development of the balanced-coupled Adcock system, retaining all the advantages of that type as regards polarisation error, but with a greatly enhanced pick-up factor compared with that of the early experimental model, which makes the apparatus capable of taking bearings with field strengths as low as 1 micro-volt per metre, and with an instrumental accuracy as good as that of a loop type Bellini-Tosi direction finder.

A Short Wave Adcock Direction Finder. (R. H. Barfield and W. Ross, J. Inst. Elec. Engs., Vol. 81, No. 491, Nov., 1937, pp. 682-90.) (50/62 Great Britain.)

This paper gives full details of the construction and performance of a short wave aural Adcock direction finder of the coupled type with a working wave length range of from 35 to 70 metres (frequency 8.6 to 4.3 mc.). It describes how the design of the instrument is based on the principles brought to light in an earlier investigation. It deals with its design in respect of polarisation error, pick-up factor, and instrumental error, and describes experiments by which these properties were measured. The values obtained for these were as follows:— Standard wave error, 3° to 8°; pick-up factor, 4.5 to 6 metres; instrumental error, 2° to 3° at maximum.

The apparatus is considered to constitute a satisfactory direction finder from a practical point of view, though it will be possible in future models, one of which is already under construction,* to take advantage of the experience gained to obtain an instrument with lower instrumental and polarisation errors and higher pick-up factor.

Electro-Magnetic Wave Fields Near the Earth's Surface. (C. R. Mingins, Proc. Inst. Radio Engineers, Vol. 25, No. 11, Nov., 1937, pp. 1419-1456.) (50/63 U.S.A.)

It is shown that in the case of frequencies where the ground wave is of importance any indirect waves can be investigated by keeping within the " sky wave furrow " of the directional pattern of a loop receptor. Observations indicate multiple down-coming waves in the daytime, with marked changes occurring toward sunset. Conditions during the day are as a rule steady and sometimes resume their steadiness after the sunset fluctuation period.

During steady conditions observations were made of the field in the neighbourhood of various systems involving boundaries between media of different conductivities. The results are interpreted on the basis of a steady field upon which is superposed a perturbation field due to a conductor or anti-conductor of conductivity $\pm\Delta\sigma$.

Several ways in which the wave plurality may be accounted for are discussed.

Transmission Theory of Plane Electro-Magnetic Waves. (S. A. Schelkumoff, Proc. Inst. Radio Engineers, Vol. 25, No. 11, Nov., 1937, pp. 1457-1492.) (50/64 U.S.A.)

This paper deals with transmission theory of plane electro-magnetic waves in free space and in cylindrical regions of arbitrary cross-section. Transmission properties of such waves can be expressed very simply in the same terms as the properties of electro waves guided by a pair of parallel wires. The earlier parts of the paper are concerned with general theorems and the later parts with their application to plane waves in metal tubes of circular and rectangular cross-section.

Methods of Two-Way Scanning in Television. (V. Denisov, Technical Physics of the U.S.S.R., Vol. 4, No. 5, 1937, pp. 383-403. In English.) (50/65 U.S.S.R.)

1. Two-way scanning of television images has a number of advantages, which tend to improve the quality of the images. The improvement is more marked as the number of elements is reduced.

2. The method shortens the necessary frequency band for high quality television, and reduces the technical difficulty of strengthening the frequency band

* This new system has now been completed. As a result of minor modifications in design the following performance has been attained: Standard-wave error, 1° to 4°; pick-up factor, 4 to 10 metres; instrumental error, 2½° (maximum).

without distortion. It thus helps to free television from its present defects near the lower limits of the short wave range.

3. The system of mechanical two-way scanning which has been developed permits reception both on mechanical and cathode televisors and may be applied for broadcasting television over greater distances when the number of elements is between 1.200 and 4.800.

German Television Exhibits at the Paris Exhibition. (P. M. Delaunay, La Science et la Vie, No. 246, Dec., 1937, pp. 474-480.) (50/66 Germany.)

The outstanding exhibit was an example of the combined television and telephone installation which is in commercial operation between Berlin, Leipzig, Nuremberg and Munich. In this system the high frequency impulses are transmitted through a special cable which is highly efficient and regarded as a triumph of German electrical engineering. (It is noteworthy that the short length of cable joining the television emitter at the base of the Eiffel Tower to the radiating antenna at the top of the tower is also of German manufacture.)

The author is of the opinion that the German television industry is well ahead of that of other countries, and whilst not embodying any new principles, the detail design is so well thought out that commercial operation becomes possible. Special attention is called to the scanning disk of the telephone installation which differs from the normal Nipkow pattern by employing a rotating lens system instead of plane holes.