ABSTRACTS AND NOTICES*

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(Prepared by R.T.P.)

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The Forces on a Circular Cylinder Submerged in a Uniform Stream. (T. H. Havelock, Proc. Roy. Soc., Vol. 157, No. 892, 2/12/36, pp. 526-534.) (41/1 3921 Great Britain.)

A solution is given for the two-dimensional wave motion due to a circular cylinder in a uniform stream, taking fully into account the condition at the surface of the cylinder. Expressions for the horizontal and vertical forces on the cylinder are obtained in the form of infinite series of ascending powers of a certain parameter. Numerical calculations are made from these and compared with the known first approximations. The main effect of the additional terms on the wave resistance is to increase the calculated value at low velocities and to decrease it slightly at high velocities.

Correlation Measurements in a Turbulent Flow through a Pipe. (G. I. Taylor, Proc. Roy. Soc., Vol. 157, No. 892, 2/12/36, pp. 537-546.) (41/2 3923 Great Britain.)

A new method for measuring R, the correlation coefficient between two fluctuating currents is described, which has the advantage that small deviations from perfect correlation can be measured accurately. The predictions given by the author in his " Statistical Theory of Turbulence " are verified.

Fluid Friction Between Rotating Cylinders. I—Torque Measurements. (G. I. Taylor, Proc. Roy. Soc., Vol. 157, No. 892, 2/12/36, pp. 546-564.) (41/3 3924 Great Britain.)

The torque between concentric rotating cylinders was measured in two cases, (*a*) inner cylinder rotating, outer cylinder fixed, (*b*) inner cylinder fixed, outer cylinder rotating. It was found, as was to be expected, that the critical speed at which turbulence begins is very much lower in case (*a*) than in case (*b*). The difference between the critical speeds in the two cases becomes rapidly greater as t/R_1 increases, t being the difference between the radii, and R_1 the radius of the outer cylinder. It appears that t/R_1 must be less than 0.001 before the effect of rotation on the critical speed disappears. When the flow is turbulent the effect of rotation on the torque is small in case (*a*) but large in case (*b*).

* In future, by arrangement with the Air Ministry, these abstracts will be published monthly.

Fluid Friction Between Rotating Cylinders. II—Distribution of Velocity Between Concentric Cylinders when the Outer One is Rotating and Inner One is at Rest. (G. I. Taylor, Proc. Roy. Soc., Vol. 157, No. 892, 2/12/36, pp. 567-578.) (41/4 3925 Great Britain.)

Two cases are considered:—(*a*) Inner cylinder rotating, outer fixed; (*b*) inner cylinder fixed, outer rotating. In case (*a*) the distribution of velocity between the cylinders has previously been measured. The far greater technical difficulty of measuring the distribution in case (*b*) has now been overcome by a new design for the inner cylinder. It is found that the stabilising effect of rotation makes it possible for large gradients of velocity to exist throughout the space between the cylinders. The distribution is therefore more like that which occurs in non-turbulent flow than that observed in case (*a*), where nearly the whole velocity changes occur quite close to the wall.

Air Flow in the Boundary Layer near a Plate. (H. L. Dryden, N.A.C.A. Report No. 562, 1936.) (41/5 4169 U.S.A.)

The intensive study of the boundary layer flow near a thin flat plate promises to yield considerable information as to the origin of eddying flow and the effect of turbulence in wind tunnel experiments. The information now available shows that the velocity field varies greatly with the turbulence of the air stream, and with the gradient pressure. The Reynolds number at which transition occurs in a stream without pressure gradient decreases greatly as the turbulence is increased. The presence of fluctuations is not an indication of the presence of eddy shearing stresses. The laminar layer shows speed fluctuations of amplitude considerably greater than that in the free stream. These fluctuations do not produce departures from the theoretical Blasius distribution for laminar flow. They are of lower frequency than the fluctuations in the eddying boundary layer. Transition is a sudden phenomenon, but the point of transition moves back and forth within rather wide limits.

Aerodynamic Characteristics of N.A.C.A. 23,012 and 23,021 Airfoils with 20 per cent. Chord External Airfoil Flaps of N.A.C.A. 23,012 Section. (R. C. Platt and I. H. Abbott, N.A.C.A. Report No. 573, 1936.) (41/6 4450 U.S.A.)

The tests were carried out in the 7 × 10ft. variable density tunnel and covered a range of Reynolds numbers corresponding to the landing condition of a wide range of aeroplanes. From the data obtained, the external airfoil flap in combination with an airfoil appears to be one of the most generally satisfactory high lift devices investigated to date. The combination tested offers a relatively high value of maximum lift coefficient with low profile drag in the high lift range. At low lift coefficients it gives very nearly as low values of profile drag as a good plain airfoil of comparable thickness. Structural and stability problems associated with the large negative pitching moments occurring at high lift coefficients may be slightly greater than in the case of ordinary and split flaps.

On the Air Resistance of Projectiles. (P. S. Epstein, Proceedings Nat. Acad. Science (U.S.A.), Vol. 17, 1931, pp. 532/547.) (41/7 4654 U.S.A.)

Using the equation of Prandtl and Meyer previously developed for supersonic flow " round a corner," the author investigates the flow round a simple polygonal contour. The solution presented only holds provided the velocity exceeds the velocity of sound by a certain amount depending on the angle of the polygon. In this case the change in density in the discontinuity (shock wave) can be found. At speeds below the velocity of sound, no discontinuity is formed, the motion of the gas not differing essentially from that given by potential flow. In the velocity region between that of sound and the minimum discussed above, a dis-

continuity of an unknown type is formed. From these radical changes in type of motion with increase of velocity, the author concludes that the representation of projectile resistance by a single formula (as is often done in practice) must necessarily lead to erroneous conclusions. In the high speed region (*i.e.*, above the minimum velocity) the author's formulæ give resistance coefficients of the same order of magnitude as obtained by experiment on rifle bullets. From this it appears that the heat losses occurring in practice do not affect the resistance appreciably and reasons for this are given by the author.

Air Resistance of Passenger Trains. (Nature, No. 3509, 30/1/37, p. 206.) (41/8 4679 Great Britain.)

The air resistance of a train of conventional British design is equivalent to about 0.0016 V^2 lb. per ton (V = speed in miles/hour). The resistance can be reduced by 20 per cent. with little trouble (engine and first coach) and by 50 per cent. if all smooth coaches are used as well. Theory indicates a possible saving of 75 per cent. Streamlining is more effective in side winds (30° to 60°) than for head-on conditions. A surprisingly large proportion of the air resistance of a coach is contributed by the bogies and undercarriage structure.

Mechanism of the Production of Small Eddies from Large Ones. (G. I. Taylor and A. E. Green, Proc. Roy. Soc., Vol. 158, No. 895, 3/2/37, pp. 499-521.) (41/9 4756 Great Britain.)

The general equations of two-dimensional motion of a viscous incompressible fluid are solved by the method of successive approximation. The original motion is on a definite scale and possesses some of the characteristics of statistically uniform isotropic turbulence. The calculated rate of dissipation is of the same order as that observed in certain tests of grids in wind tunnels.

Wing-Nacelle-Propeller Interference for Wings of Various Spans, Force, and Pressure-Distribution Tests. (R. G. Robinson and W. H. Herrnstein, N.A.C.A. Tech. Report No. 569, 1936.) (41/10 3650 U.S.A.)

An experimental investigation was made in the N.A.C.A. full-scale wind tunnel to determine the effect of wing span on nacelle-propeller characteristics and, reciprocally, the lateral extent of nacelle and propeller influence on a monoplane wing. The results provide a check on the validity of the previous research on nacelles and propellers with 15-foot span wings tested in the 20-foot wind tunnel and reported in Technical Reports 415, 436, 462, 505, 506, and 507. The 4/9 scale propeller and the N.A.C.A. cowling used in the former researches were tested in three typical tractor locations with respect to a thick wing of 5-foot chord and 30-foot span. The span was progressively reduced to 25, 20 and 15 feet and the same characteristics were measured in each case. All important effects of 4/9 scale nacelle-propeller combinations may be measured within practical limits of accuracy by tests of a 15-foot span wing.

The Reduction of Aileron Operating Force by Differential Linkage. (R. T. Jones and A. I. Nerken, N.A.C.A. Tech. Note No. 586, Dec., 1936.) (41/11 4170 U.S.A.)

It is shown that the control force of ordinary ailerons may be reduced to zero over a range of deflections and at a given flight condition by the use of an appropriate differential movement. Approximations to the ideal motion obtainable with a simple linkage are discussed and a chart that enables the selection of an appropriate crank arrangement is presented. Various aspects of the practical application of the system are discussed and it is concluded that a small fixed tab, deflected to trim both ailerons upward, would be advantageous.

The Next Five Years in Aviation. 1.—*Fuels.* 2.—*Diesel Engines.* 3.—*Stability and Control.* 4.—*Size and Performance of Aircraft.* 5.—*Progress in Aeroplane Aerodynamics.* 6.—*Aircraft Structures.* (J. Aer. Sci., Vol. 4, No. 2, Dec., 1936, pp. 74-78.) (41/12 4287 U.S.A.)

Various authors made the following predictions:—(1) *Fuels.* 100 octane fuel will come in general use and higher octane ratings will become available for special purposes. For these high numbers, the rating procedure will have to be perfected. (2) *Diesel Engines.* These will mark time, as carburettor fuel developments appear to offer greater advantages for the spark ignition engine. (3) *Stability and Control.* Large aeroplanes present serious problems which are not overcome by the automatic pilot, but will require special design features. (4) *Size and Performance.* Size will go up to 50 tons gross weight, operational speed 200 m.p.h., operational height 20,000 feet. Arrangement of four engines in a horizontal line will be most common. (5) *Aerodynamics.* Reversible propellers and other methods of speed control will receive attention. Bad weather flying qualities will improve (de-icers, etc.). (6) *Structures.* With increase in size, the percentage of structural weight will decrease from the present 33 to 25 per cent. The stressed skin structure will hold the field as it is definitely superior to alternatives like the geodetic.

Flight Measurements of the Dynamic Longitudinal Stability of Several Airplanes and a Correlation of the Measurements with Pilots' Observations of Handling characteristics. (H. A. Soulé, N.A.C.A. Report No. 578, 1936.) (41/13 4662 U.S.A.)

The dynamic longitudinal stability characteristics of eight aeroplanes, as defined by period and damping of the oscillations, were measured. The observed period increased with the speed of the aircraft from an average of 15 seconds (low speeds) to 45 seconds (high speeds). The damping showed no definite effect of speed. It appears that neither the period nor the damping of the longitudinal oscillations influenced the opinion of the pilots concerning the handling characteristics of the aircraft.

Theoretical Span Loading and Moments of Tapered Wings Produced by Aileron Deflection. (H. A. Pearson, N.A.C.A. Tech. Note No. 589, January, 1937.) (41/14 4788 U.S.A.)

The effect of tapered ailerons on linearly tapered wings is theoretically determined. Four different aileron spans are considered for each of three wing aspect ratios and each of four wing taper ratios. The change in lift on one half of the wing, the rolling moment, the additional induced drag, and the yawing moment, due to aileron deflection, are represented by non-dimensional coefficients. Similar coefficients are given for the damping and yawing moments, the additional drag, and the change in lift due to rolling. It was found possible to effect a fairly close agreement between the theoretical and experimental rolling moments by introducing into the theoretical expression for the rolling moment an effective change in angle of attack obtained from an analysis of flap data. The theoretical curves show that the highly tapered wing with long ailerons has a lower ratio of yawing to rolling moment and a lower additional induced drag than wings with less taper.

Hydrodynamic Tests in the N.A.C.A. Tank of a Model of the Hull of the Short Calcutta Flying Boat. (K. E. Ward, N.A.C.A. Tech. Note No. 590, January, 1937.) (41/15 4798 U.S.A.)

The hydrodynamic characteristics of a model of the hull of the Short Calcutta (N.A.C.A. Model 47) are presented in non-dimensional form. This model represents one of a series of hulls of successful flying boats of various nationalities,

the characteristics of which are being obtained under similar test conditions in the N.A.C.A. tank. The take-off distance and time for a flying boat having the hull of the Calcutta are compared at two values of the gross load with the corresponding distances and times for the same flying boat having hulls of two representative American types, the Sikorsky S-40 and the N.A.C.A. 11-A. This comparison indicates that for hulls of the widely different forms compared, the differences in take-off time and distance are negligible.

Determination of the Characteristics of Tapered Wings. (R. F. Anderson, N.A.C.A. Report No. 572, 1936.) (41/16 4848 U.S.A.)

Tables and charts for use in determining the characteristics of tapered wings are presented. Theoretical factors are given from which the following characteristics of tapered wings may be found:—The span lift distribution, the induced angle of attack distribution, the lift curve slope, the angle of zero lift, the induced drag, the aerodynamic centre position, and the pitching moment about the aerodynamic centre. In addition to the tables and charts, test results are given for nine tapered wings, including wings with sweepback and twist. The test results verify the values computed by the methods presented in the first part of the report. A final section is given outlining a method for estimating the lift coefficient at which tapered wing begins to stall. This method, which should be useful for estimating the maximum lift coefficient of tapered wings, is applied to one of the wings tested.

Propulsion of a Flapping and Oscillating Airfoil. (I. E. Garrick, N.A.C.A. Report No. 567, 1936.) (41/17 4849 U.S.A.)

Formulæ are given for the propelling or drag force experienced in a uniform air stream by an airfoil or an airfoil aileron combination, oscillating in any three degrees of freedom: Vertical flapping, torsional oscillations about a fixed axis parallel to the span, and angular oscillations of the aileron about a hinge.

Full-Scale Span Load Distribution on a Tapered Wing with Split Flaps of Various Spans. (J. F. Parsons and A. Silverstein, N.A.C.A. Tech. Note No. 591, Feb., 1937.) (41/18 4850 U.S.A.)

Pressure distribution tests were conducted in the full-scale wind tunnel on a 2 to 1 tapered U.S.A. 45 airfoil equipped with 20 per cent. chord split trailing edge flaps of various spans. A special installation was employed in the tests utilising a half span airfoil mounted vertically above a reflection plane. The airfoil has a constant chord centre section and rounded tips and is tapered in thickness from 18 per cent. *C* at the root to 9 per cent. *C* at the tip. The aerodynamic characteristics, given by the usual dimensionless coefficients, are presented graphically as functions of flap span and angle of attack as well as by semi-span load diagrams. The results indicate, in general, that only a relatively small increase in the normal force coefficient is to be expected by extending the flap span of an airfoil flap combination, similar to the one tested, beyond 70 per cent. of the wing span.

The Homing Pigeon—What Brings Them Home? (J. F. Vance, Sci. Am., Vol. 156, No. 3, March, 1937, pp. 154-157.) (41/19 4885 U.S.A.)

Although the answer to this question is still to be found, the following facts may ultimately help in obtaining an explanation. (1) The homing pigeon is the only type of bird which possesses the homing ability in any useful degree. (2) Breeding and training can increase the range of flight remarkably. (3) Homing pigeons will fly round storms and fog and generally choose the easiest (not necessarily the most direct route). (4) As a rule, they do not fly at night. (5) They do not require a bird's-eye view of the course. Cases have occurred where the birds, due to wing injury, have walked home. (6) The pigeon's ears

contain a system of semi-circular canals. If ears are stopped or canals injured, the bird appears to lose the homing instinct. (7) The pigeons have remarkable eyesight. (8) Their sense of direction finding is completely upset if released in close proximity to a wireless broadcasting station. On the strength of the above it is suggested that the pigeon in some way reacts to the earth's magnetism and therefore steers a compass course. The world homing record (1931) is 7,200 miles in 24 days (Arras, France, to Saigon, Indo-China). On the above theory, the bird on the outward journey memorised the general magnetic direction. As the bird travelled in a wicker basket in the hold of a ship from Saigon to Marseilles, there was obviously no opportunity for picking up landmarks by eye. Considerable further experiment is, however, required before this theory can be considered as established.

Effect of Several Factors on the Cooling of a Radial Engine in Flight. (O. W. Schey and B. Pinkel, N.A.C.A. Tech. Note No. 584, Nov., 1936.) (41/20 3651 U.S.A.)

Flight tests of a Grumman Scout (XSF-2) airplane fitted with a Pratt and Whitney 1535 supercharged engine were conducted to determine the effect of engine power, mass flow of the cooling air, and atmospheric temperature on cylinder temperature. The tests indicated that the difference in temperature between the cylinder wall and the cooling air varied as the 0.38 power of the brake horse-power for a constant mass flow of cooling air, cooling air temperature, engine speed, and brake fuel consumption. The difference in temperature was also found to vary inversely as the 0.39 power of the mass flow for points on the head and the 0.35 power for points on the barrel, provided that engine power, engine speed, brake fuel consumption, and cooling air temperature were kept constant. The results of the tests of the effect of atmospheric temperature on cylinder temperature were inconclusive owing to unfavourable weather conditions prevailing at the time of the tests. The method used for controlling the test conditions, however, was found to be feasible.

The Quiescent Chamber Type Compression-Ignition Engine. (H. H. Foster, N.A.C.A. Report No. 564, 1936.) (41/21 3964 U.S.A.)

Experiments were carried out on a four-stroke single cylinder engine with a vertical disc-shaped combustion chamber. There is evidence that any air movement that may occur in the chamber has no marked effect on the distribution of the fuel and for this reason the term " quiescent " has been applied. The inferior performance compared with that obtained from the same combustion chamber with forced air flow, despite easy starting, easy scavenging, low mechanical losses and freedom from knock renders this type of combustion chamber unattractive for aircraft engine use.

Heat Loss in High Speed I.C. Engines. (W. T. David, Engineer, Vol. 162, No. 4224, 25/12/36, pp. 675-676.) (41/22 4076 Great Britain.)

Taking recent values for the specific heat and dissociation constants Prof. David has calculated the ideal engine efficiencies obtainable with a number of gaseous fuels. These are compared with indicated efficiency obtained by adding the motoring losses to the b.h.p. In the cases cited, the average difference in efficiency amounts to 2.6 per cent., which, if entirely put down to heat loss, is only half the amount generally accepted. From this the author concludes that the heat loss in practice is really very much less and that the present high speed engines approach much more closely to thermodynamic perfection than is generally supposed.

ABSTRACTOR'S NOTE.—The author's argument rests on the relative accuracy obtainable both for the ideal and indicated efficiencies. If the old heat loss values

are retained, it simply means that the difference between these two efficiencies as calculated by the author is in error by a corresponding amount and it seems that such a possibility cannot be excluded.

The Cracking of Stellited Valve Seats and the Mean Coefficient of Thermal Expansion of Two Stellites. (H. Cornelius and F. Bollenrath, Z.F.M., Vol. 28, No. 12, Dec., 1936, pp. 383-385. Available as Translation No. 414.) (41/23 4348 Germany.)

The mean thermal expansion coefficients of the stellites were obtained between 20°C. and a higher temperature ranging from 100°C. to 850°C. The curves were compared with those obtained for valve steel over the same range. Throughout, the stellite has a smaller coefficient, the mean value being 13.5×10^{-6} and 18×10^{-6} for stellite and steel respectively, over the range 20°-750°C. The cracking of stellited steels is attributed to this difference in expansion and this view is confirmed by micro-photographs of sections.

The Forces and Moments on Airplane Engine Mounts. (P. Donely, N.A.C.A. Tech. Note No. 587, Dec., 1936.) (41/24 4449 U.S.A.)

A résumé of the equations and formulæ for the forces and moments on an aircraft engine mount is presented. In addition, available experimental data have been included to permit the computation of these forces and moments. A simple calculation is made and compared with present design conditions for engine mounts.

Motor Fuel Patent (Addition of Metallic Nitrates). (I. C. Nourse, Chem. Absts., Vol. 30, No. 21, 10/11/36, p. 7823. U.S. Patent No. 2,055,503.) (41/25 3728 U.S.A.)

A small proportion of a nitrate such as that of Cd, U, Al, Fe or K is added and serves to facilitate complete combustion. The nitrate, *e.g.*, Cd $(No_3)_2$, may be preliminarily distilled together with a solvent such as iso-Pr alc. and C_6H_6 and the distillate added to the main body of the motor fuel.

The Kinetics of the Combustion of Methane. (R. G. W. Norrish and S. G. Foord, Proc. Roy. Soc., Vol. 157, No. 892, 2/12/36, pp. 503-525.) (41/26 3920 Great Britain.)

The kinetics of the combustion of methane have been investigated with particular reference to the slow reaction. The velocity of the reaction has been found to be proportional to the square of the concentration of methane and the first power of the concentration of oxygen, and approximately proportional to the total pressure. The effect of surface has been examined and the almost complete inhibition of the reaction in packed vessels confirmed. Ignition has been shown to be a thermal process consequent upon the attainment of a critical reaction velocity. A kinetic mechanism for the combustion of methane has been proposed, based upon the atom chain theory modified to include the phenomenon of degenerate branching.

Relationships Between Physical Properties and Chemical Constitution of Lubricating Oil Fractions. (B. J. Mair and C. B. Willingham, Bur. Stan. J. Res., Vol. 17, No. 6, Dec., 1936, pp. 923-942.) (41/27 4629 U.S.A.)

The following properties were compared: Densities, specific refractions, optical activities, specific dispersions, viscosities, viscosity indices, aniline points, and boiling points. It appears that the least soluble portion of the oil consists substantially of naphthenes (cyclo-paraffins) containing from one to about three rings to the molecule, together with the necessary alkyl radicals. The somewhat more soluble portion consists of naphthenes with more rings, together with some unsaturated hydrocarbons and possibly some aromatic hydrocarbons. Because

of the similar solubility relations, it is possible that in the extraction processes as used at the present time one-ring aromatic hydrocarbons are being discarded to waste along with the undesirable naphthenes containing about six rings to the molecule. This is a point well worth investigating, since these one-ring aromatic hydrocarbons may be a valuable constituent for good lubricating oil.

From the Periodic Table to Production (Discovery of Tetra-Ethyl Lead and Freon Refrigerant). (Chem. and Ind., Vol. 56, No. 6, 6/2/37, pp. 133-136. See also Ind. & Eng. Chem. (Industrial Edn.), Vol. 29, No. 2, Feb., 1937, pp. 241-244.) (41/28 4658 Great Britain.)

On the occasion of his reception of the Perkin Medal, T. Midgley, Jr., gave an interesting account of the discovery of tetra-ethyl lead. Attributing the knocking of paraffin fuel to delayed vaporisation, he attempted to overcome this by dyeing the fuel with some oil soluble dye. A suitable dye not being immediately available, he used iodine and thus discovered its anti-knock effect. As soluble dyes when tried subsequently gave no effect, whilst colourless ethyl iodide worked, the radiant heat explanation had to be dropped in favour of some specific chemical effect. The search was concentrated in that section of the periodic table containing iodine and was soon rewarded by the discovery of the efficiency of diethyl telluride and ultimately by that of tetra-ethyl lead. A similar interesting account of the discovery of the refrigerant Freon (dichloro-monofluoro-methane) on the strength of predictions based on the periodic classification is given.

ABSTRACTOR'S NOTE.—The lecturer made no reference to the well known anti-knock effect of iron and nickel carbonyls and it does not appear that their effectiveness could have been predicted from the periodic classification.

Lubricating Bearing Surfaces in Internal-Combustion Engines so as to Prevent Corrosion. (R. C. Moran and others, Chem. Absts., Vol. 31, No. 1, 10/1/37, p. 252, U.S. Patent No. 2,058,342.) (41/29 4795 U.S.A.)

In lubricating bearing surfaces such as those of automobile engines where one of the surfaces is formed chiefly of a Cd or Cu alloy, with a film of lubricating oil which would otherwise tend to develop a corrosive action on the metal, corrosion is prevented by adding to the lubricant a small proportion (suitably about 0.1-1.0 per cent.) of triphenyl phosphite. U.S. patent 2,058,343 relates to the like use of an aryl phosphite such as tri-β-naphthyl phosphite as a corrosion preventive, and U.S. patent 2,058,344 relates to a similar use of tritolyl phosphite.

Electro-Magnetic Control of High Rotational Speed. (T. Davis, Z. Instrum., Vol. 56, No. 11, Nov., 1936, p. 477. Rev. Scient. Instr., Vol. 7, 1936, pp. 96-98.) (41/30 3817 Germany.)

The control applies to air-driven rotors, which are modified so as to act as the rotating magnetic system of a synchronous electric motor, the stationary magnetic field being varied at a definite rate by means of a tuned valve circuit. The modification to the normal phosphor-bronze rotor can be carried out very simply by fitting a short bar magnet immediately above the pivot. The stationary field is wound on a core of silicon steel surrounding the pivot. It is possible to make the drive entirely electric, the air being simply used to float the rotor. Speeds of the order of 1,000-2,000 rev./sec. can be easily synchronised.

Portable Photo-Electric Daylight Factor Meter. (G. P. Barnard, J. Sci. Inst., Vol. 13, No. 12, Dec., 1936, pp. 392-403.) (41/31 3951 Great Britain.)

The practical conditions controlling the accuracy of measurement of daylight factor are considered in the first section of the paper. A simple portable photo-electric daylight factor meter, incorporating two rectifier photo-electric cells, is

described. The direct range of daylight factor measurable by the meter is from 0.03 to 2.5 per cent. The limits of error in the measurement of daylight factor by means of the meter are considered to be about ± 10 per cent., so that the accuracy compares favourably with that normally obtainable by visual methods of measurement. No calculation need be involved in practical working, for the daylight factor can be related to the value of a variable balancing resistance included in the meter circuit. Curves relating to daylight factor and resistance are given.

Absolute Viscosity Measurements at the German Reichsanstalt. (S. Erk and A. Schmidt, Z. Instrum., Vol. 57, No. 1, January, 1937, pp. 34-36.) (41/32 4664 Germany.)

Two capillaries of equal diameter, but different length, are placed in series and the relative pressure drop measured, the fluid under investigation being forced through the circuit by means of air pressure and weighed on exit. An accuracy of ± 0.2 per cent. is claimed.

The Vaisala Statoscope Applied to Aero-Photographic Survey. (K. Lofström, Z. Instrum., Vol. 57, No. 1, January, 1937, p. 37.) (41/33 4665 Germany.)

The statoscope consists of an enclosed volume of air communicating with a liquid manometer and enables the pilot to maintain constant altitude within ± 5 m., the range of the instrument being ± 40 m. In case of need for greater accuracy, a photographic recording device can be fitted to the instrument and change of zero during the flight recorded. It is stated that the instrument has given good service in Finland for stereoscopic photographic survey.

New Developments in Photo-Elasticity. (L. Föppl, Z.V.D.I., Vol. 81, No. 6, 6/2/37, pp. 137-141. With bibliography.) (41/34 4729 Germany.)

In photo-elastic investigation of plane stresses, the following fundamental equation is employed

$$\gamma = C\,(\sigma_1 - \sigma_2)\,d$$

where γ = phase difference of two transmitted rays corresponding to a single plane polarised incident ray.

d = thickness of plate.

σ_1 and σ_2 = principal stresses.

C = constant for material of plate.

As long as the stresses are two-dimensional, σ_1 and σ_2 are constant throughout the thickness d. If, however, we consider the three-dimensional case, the phase difference γ of the transmitted rays depends on the variation of σ_1, σ_2 and σ_3 throughout the thickness and its measurement throws no light on the stress distribution. Now experiment has shown that the phase difference γ really depends on the strain or deformation of the material, but as long as the process is elastic the measured γ is proportional to either. If it were possible in a body to remove all stress, but retain the strains, the optical behaviour in polarised light would not be affected. If such a body were then subsequently cut, the various sections, provided they are small enough, could be investigated for their remanent strains by the same methods as already applied to the two-dimensional case. Certain kinds of synthetic resins possess this quality when suitably heat treated and it appears likely that this discovery by Oppel will be of the greatest use in solving three-dimensional problems.

Resistance of Projectile when Passing Through a Rifle Barrel. (Z.V.D.I., Vol. 81, No. 6, 6/2/37, p. 141.) (41/35 4730 Germany.)

The resistance is a combination of friction and work of plastic deformation. The process is too complicated for mathematical analysis and direct experiment

is also very difficult. The procedure has, therefore, been to approximate to practical conditions in the experiment and extrapolate. The following formula is suggested:—

$$R_{max} = C_n (Q - q) \{ a_1/(a_1 + a_2) \} (b_1/b_2)$$

where R_{max} = max. resistance.

Q = max. cross-section of guide ring on projectile.
q = reduced cross-section of ring when passing through rifling.
a_1, a_2 = width of rifling at top and bottom of groove.
b_1, b_2 = width of guide ring under comparison.
C_n = experimental constant.

Causes of the Variation of Sharpness of Vision with Colour of Light. (H. Schober and H. Jung, Z. Instrum., Vol. 56, No. 11, Nov., 1936, pp. 475-476. Zeitschrift f. Techn. Physik, Vol. 17, 1936, pp. 84-93.) (41/36 3816 Germany.)

Chromatic aberration has little influence on sharpness of vision which is mainly a function of wave-length of light and reaches a maximum for wave-length between 5,500 and 5,780 A. The normal mercury vapour lamp radiates in that region and is thus to be preferred to the sodium vapour lamp. The latter radiates principally on longer wave-lengths, as do also high pressure mercury vapour lamps.

The Oscillations of the Atmosphere. (H. Jeffreys and G. I. Taylor, Proc. Roy. Soc., Vol. 157, No. 892, 2/12/36, pp. 535-537.) (41/37 3922 Great Britain.)

Reference is made to a previous paper (Proc. Roy. Soc. (A.), Vol. 156, 1936, pp. 318-326) by H. Jeffreys on the periodic winds associated with a given periodic variation of temperature. The assumption made by Jeffreys is that the temperature at a fixed point in space remains unchanged during an oscillation and this enabled him to derive an expression in the form of an integral through the height of the atmosphere. Prof. Taylor points out that the equivalent height has little connection with the free oscillation of the atmosphere occurring either under isothermal or adiabatic conditions and that the true equivalent height is not expressible as definite integrals through the height of the atmosphere.

Selection of Colours for Signal Lights. (H. J. McNicholas, Bur. Stan. J. Res., Vol. 17, No. 6, Dec., 1936, pp. 955-980.) (41/38 4630 U.S.A.)

Various coloured lights produced by combinations of a tungsten filament lamp and commercially available coloured glass light filters were tested for efficiency and accuracy of identification in each of two six-colour signal systems consisting, respectively, of red, orange-yellow, white, green, blue, and purple lights, and of red, orange, yellow, white, green, and blue lights. The tests were made by 38 normal observers on an outdoor range of 950 feet, for different weather conditions and signal intensities. Comparison between the two systems under prescribed service conditions showed that the use of purple with adequate lamp intensity is preferable to the use of both orange and yellow with red and white. Partial chromaticity tolerances and minimum lamp intensities have been determined for the six-colour system containing purple.

Electrical Stimulation of the Human Cochlea. (Nature, No. 3,509, 30/1/37, p. 192.) (41/39 4677 Great Britain.)

It has previously been shown that stimulation of the human cochlea by audio frequency alternating currents results in a sensation of tone corresponding in pitch to the frequency of the stimulation. There is a possibility that the mechanism of excitation is by direct stimulation of the cochlear nerve fibrils. As an alternative, the authors suggest that the stimulation is indirect, the cochlear

elements which normally are set in motion by physiologically applied sound waves being now stimulated in a manner not yet understood. The arguments are mainly based on the observation of a phase change beat under electrical stimulation. The movement theory of cochlear response is thus confirmed.

First Aid in Case of Burns. (Autom. Tech. Zeit., Vol. 40, No. 1, 10/1/37, p. 24.) (41/40 4694 Germany.)

A burn should never be treated with water. Bathing with oil often leads to complications, since the oil is seldom sterile. As a result of considerable experience, the author recommends treating the wound with absolute alcohol and subsequently with a 5 per cent. tannin solution. It is most important that the treatment should be applied immediately after the accident, as a delay of a few minutes may seriously affect the possible recovery. The tannin treatment has reduced mortality from 30 to 2 per cent. in cases of extensive burns.

Atmospheric Oscillations. (C. L. Pekeris, Proc. Roy. Soc. (Series " A "), Vol. 158, No. 895, 3/2/37, pp. 650-671.) (41/41 4757 Great Britain.)

Assuming the Whipple temperature distribution for the atmosphere between 30 and 60 km., it is possible to find a temperature distribution above 60 km. such that the atmosphere has a free oscillation period very close to 12 solar hours. It is also found that another mode of oscillation of a period of $10\frac{1}{2}$ hours and having no nodal surface exists. Experimental results based on barometric oscillation (12-hour period) due to tidal resonance are thus reconciled with geophysical phenomena (speed of sound wave of Krakatau eruption points to a period of $10\frac{1}{2}$ hours).

Colour Photographs for Aerial Survey. (A. Meilbeck, Z. Instrum., Vol. 57, No. 1, January, 1937, pp. 37-38.) (41/42 4666 Germany.)

The two-lens camera takes simultaneous pictures (9 by 12 cm.) through suitable red and green filters. Subsequent observation is binocular, each plate being suitably illuminated and the two sets of rays being made to overlap. Provision is made at the same time for the uniform projection of a blue light over the whole field of view.

Oscillations in an Electro-Mechanical System. (L. W. Hussey and L. R. Wrathall, Bell Tele. Pubs., B-940, July, 1936.) (41/43 3683 U.S.A.)

Experimental results are given obtained with an oscillating electro-mechanical system in which, under a single frequency impressed electro-motive force, mechanical vibrations are sustained at a frequency near the resonant frequency of the mechanical system and electrical oscillations at the difference between the frequency of the mechanical vibration and that of the impressed force. The system is one studied analytically by R. V. L. Hartley in an accompanying paper. Its performance conforms to the principal operating features predicted in his analysis.

The Present Limitations and Future Possibilities of Voltage Amplification by Their Thermionic Valves. (F. M. Colebrook, J. Sci. Inst., Vol. 13, No. 12, Dec., 1936, pp. 381-385.) (41/44 3950 Great Britain.)

There are at present two principal limitations to the useful voltage amplification obtainable by means of thermionic valves—*noise and inability to handle high frequencies. Noise is partly due to thermal agitation and partly electronic. More exact knowledge of the cause (especially at radio frequencies) is required* before remedies can be indicated. The inability to handle high frequencies is bound up with the transit time of the electron. In ordinary valve structures, this is of the order of 10^{-9} sec. and thus approximates to 10 per cent. of the period

of a 3 m. wave. This calls either for reduced dimensions of the valve (so-called " acorn " type) or the adoption of a curved path for the electrons (magnetron valve).

Application of Conventional Vacuum Tubes in Unconventional Circuits. (F. H. Shepard, Jr., Proc. Inst. Rad. Eng., Vol. 24, No. 12, Dec., 1936, pp. 1573-1581.) (41/45 4102 U.S.A.)

The following circuits are described:—(1) A two-stage photo amplifier relay circuit operating directly on the alternating current line and using a voltage divider, one resistor and three condensers as circuit parts. (2) A sensitive photo amplifier circuit using a pentode as the load resistor for a photo tube and a standard tube as a reliable and sensitive electro-meter tube feeding a low priced indicating instrument. (3) A modification of (2) to provide variable range, variable sensitivity characteristics. (4) A simple vacuum tube circuit in which standard unselected tubes can be used to multiply currents of the order of 10^{-12} amperes by a definite factor (fixed by the circuit elements and not by the tubes) to such values that they can be easily read on an insensitive milliammeter. (5) A simple capacitance operated relay working on the alternating current line, using metal tubes and only a few inexpensive circuit parts.

Concerning New Methods of Calculating Radiation Resistance, either with or without Ground. (W. W. Hansen and J. G. Beckerley, Proc. Inst. Rad. Eng., Vol. 24, No. 12, Dec., 1936, pp. 1594-1621.) (41/46 4103 U.S.A.)

New general methods of computing radiation resistance, either with or without ground, are described and illustrated by examples. The formulæ are general, exact and practical, and allow the calculations to be made for any form of antenna over a plane earth of arbitrary characteristics. As the mathematical basis of these methods has been explained elsewhere the present paper gives no proofs or derivations of formulæ, but rather illustrates the method of use of the theory by computing radiation resistances for a number of typical antennæ. In connection with these computations various time-saving graphical methods are explained and tables of functions and expansions useful in the calculations are given.

On the Nature of Atmospherics. (E. V. Appleton and F. W. Chapman, Proc. Roy. Soc., Vol. 158, No. 893, 1/1/37, pp. 1-22.) (41/47 4207 Great Britain.)

A series of observations on rapid changes in the earth's electric field associated with lightning flashes has been made, using a Wilson sphere as the exposed conductor and a cathode ray oscillograph with photographic registration. The measurements have included observations both on the time change and the rate of change of the electric field. From observations made at increasing distances from the discharge, the evolution of the atmospheric wave form has been studied. At a distance of about 40-60 km. the radiation field of the atmospheric is approximately equal to the electrostatic field change of the main discharge.

The Effect of a Vertical Dipole Transmitter on a Plane Earth at Distances of the Order of a Wave Length. (K. F. Niessen, Ann. d. Phys., Vol. 28, No. 3, Feb., 1937, pp. 209-224.) (41/48 4663 Germany.)

The author shows how to modify the well known Sommerfeld equations so as to make them applicable at short distances from a dipole. The correction terms are tabulated and depend on whether the electrical or magnetic force component is measured at reception. In a subsequent publication the author intends to deal with distances up to several wave lengths. The results are of importance for determining the strength of a transmitting station from field measurements carried out in the vicinity.

Centimetre Radio Waves. (Nature, No. 3509, 30/1/37, p. 201.) (41/49 4678 Great Britain.)

Details of a split anode magnetron valve are given, the outside diameter of the glass envelope being 0.45 cm. This valve produced waves 0.64 cm. long readily detectable at 15 m. Whilst such substances as black paper, ebonite and wood are transparent to the waves, it appears that their absorption by the water vapour in the atmosphere is such as to render doubtful their application to radio communication.

The Surface Wave in Radio Propagation Over Plane Earth. (C. R. Burrows, Proc. Inst. Rad. Eng., Vol. 25, No. 2, Feb., 1937, pp. 219-229.) (41/50 4893 U.S.A.)

The results of Weyl for radio propagation over plane earth are found to differ from those of Sommerfeld by exactly Sommerfeld's surface wave. Experiments conducted under conditions in which these two theories differ greatly are entirely consistent with Weyl's results and show that Sommerfeld's surface wave is not set up by simple antennas. Accordingly the Sommerfeld-Rolf curves are in error for all conditions for which the dielectric constant cannot be neglected.

Partial Suppression of One Side Band in Television Reception. (W. J. Poch and D. W. Epstein, Proc. Inst. Rad. Eng., Vol. 25, No. 1, Jan., 1937, pp. 15-31.) (41/51 4894 U.S.A.)

An experimental and theoretical study was made for the purpose of determining the advisability of operating a television system with the carrier located near one edge of the over-all selectivity curve. Satisfactory results are obtained when operating a television system with the carrier at one edge of the over-all selectivity characteristic. The fact that fewer stages of amplification are necessary in the intermediate frequency amplifier of the receiver, when the carrier is tuned to one edge of the intermediate frequency selectivity curve, makes it very desirable to adopt this system.