

ABSTRACTS AND NOTICES  
FROM THE  
SCIENTIFIC AND TECHNICAL PRESS

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

No. 19. JUNE, 1931

***Aircraft Design***

*Model and Full-Scale Tests.* (R. Pris, Tech. Aéron., Vol. XXII, No. 112, Feb., 1931, pp. 34-47.) (5.1/21301 France.)

Test results are collected from a number of sources, and an attempt is made to co-ordinate the results, which are exhibited graphically. Various discrepancies are brought out and an explanation is attempted.

*Aeroplane Structural Problems.* (K. Thalau, Z.F.M., Vol. XXII, No. 8, 28/4/31, pp. 229-241, 217th D.V.L. Report.) (5.15/21302 Germany.)

A brief survey is given of various types of monoplane and biplane construction, and of the internal construction of wings. Methods of static tests are discussed, illustrated for a particular case by a photograph and a diagram of frame loadings.

The properties of steel and timber girders are compared, and photographs of typical failures are given. Stresses imposed by the engine may be investigated by engine tests carried out in the aeroplane, which is suspended by rubber stays and is free to vibrate. A photograph exhibits fatigue fractures at four points of the welded tubular engine mounting tested in this way, the fractures all taking place just beyond the welded-on stiffening webs.

A summary is given of further investigations undertaken.

*High Altitude Monoplane.* (Flugsport, Vol. XXIII, No. 8, 15/4/31, p. 167.) (5.15/21303 Germany.)

Junkers, in co-operation with the D.V.L., are designing a high altitude low-winged monoplane, span 28 metres, flying weight of approx. 4,000 kg. The airtight double-walled cabin can be kept at a reasonable pressure, the controls being worked through stuffing boxes. A special engine and super-charger have been developed for preliminary flights up to 11,000 m., and improved super-charger should increase the height to 15,000 m.

*Development of the Long-Range Flying Boat.* (J. D. Rennie, Flight, Vol. XXIII, No. 19, 8/5/31, pp. 413-416, and No. 20, 15/5/31, pp. 434-437.) (5.15/21304 Great Britain.)

The author discusses the broad outlines of the subject from the point of view of airworthiness, seaworthiness, and ton-mile performance. He states that the majority of British flying-boats are designed as a compromise between these qualities, and puts forward the idea that air performance might well be sacrificed to give real seaworthiness of an altogether higher standard, which would render disaster after a forced landing improbable.

Starting performance, economical speed, and cruising consumption are discussed qualitatively by means of graphical charts, with a range of from 40,000 to 90,000 lbs. total weight. The curve of fuel disposition ranges from 20,000 to 30,000 lbs. total weight.

There are four photographs of British flying boats.

*Design of Sea-Going Aircraft.* (A. Gouge, J.R.Aer.Soc., Vol. XXXV, No. 245, May, 1931, pp. 341-371.) (5.51/21305 Great Britain.)

Consideration is chiefly given to hull and float shapes and characteristics, and numerous tank tests are given graphically, showing resistance and moment as functions of speed and attitude. The observed distribution of pressure on a flat hydroplane blade at an incidence of  $10^\circ$  is plotted as a family of isopressure curves.

The time of take-off, and the length of run, are shown against total weight for different air densities. The ratio of seaplane float weight to total weight is plotted from 2,200 lbs. to 22,000 lbs. and the measured points lie nearly on a straight line.

Reference is made to a new large flying boat, total weight 37,500 lbs., for which a range of 2,400 miles is shown, carrying fuel only as disposable load. No detailed data nor independent tests are given for comparative valuation of this performance.

Photographs of eleven seaplanes and flying boats are reproduced. An informative discussion follows.

*Influence of Spar Weight on Performance of Large Aeroplanes.* (E. v. Loss1, Z.F.M., Vol. XXII, No. 6, 28/3/1931, pp. 157-161.) (5.154/20307 Germany.)

The usual relation between size and strength, known as "the law of the cubes," is embodied in the equations developed with modifications taking into account various departures from dynamical similitude, such as the distribution of loads along the span. A comparison of the coefficients of structural weight between cantilever monoplane wings and braced biplane wings is given graphically. By differentiating the expression for total equivalent resistance with respect to span, a minimum value is obtained which is shown graphically in non-dimensional form. Curves of ton-mile performance and maximum range are given likewise.

The general formula for effective resistance includes a number of coefficients taken from practice, which renders comparison with other methods difficult. In the discussion the view was put forward that the distribution of load along the span does not reduce the weight appreciably. Difficulties in estimating the share of structural load taken up by metallic wing covering were mentioned. At present this can be settled only in a purely empirical manner from experience.

*Giant Aircraft, Useful Load.* (E. Jones, Aero Digest, Vol. XVIII, No. 4, April, 1931, p. 50.) (5.154/21308 U.S.A.)

A discursive article on giant aeroplanes, illustrated by photographs, includes (p. 228) a table of useful load plotted against total weight. In the American examples, of which 34 are given, ranging from 4,000 to 22,000 lbs. total weight, there is a decided tendency for the useful load to fall off with size.

In the 37 European examples, ranging from 4,400 to 99,200 lbs. total weight, the table exhibits roughly a contrary tendency.

The run of the figures is extremely irregular, and, in the absence of reliable constructional and test data, particularly of reliable load factors, it would be rash to draw any conclusion.

A comparison of aeroplane with airship is decidedly against the latter.

*Distribution of Aerodynamical Velocities Round an Aeroplane in Flight.* (A. Magnan and A. Sainte-Laguë, C.R., Vol. CXCII, No. 13, 30/3/31, pp. 795-797.) (5.1/21309 France.)

A full scale exploration of the velocity field round an aeroplane was carried out by means of a movable Venturi tube. The speed of the aeroplane was taken as 182 km. per hour from a fixed Venturi tube at a suitable point near the wing tip. Local velocities were measured at fourteen other points, the highest being 248 km. per hour behind the airscrew and above the left wing, and the lowest 146 km. per hour behind the trailing edge.

*Effect on Boundary Layer and Wing Characteristics of Internally Connected Orifices on Suction Side.* (I. H. Abbott, N.A.C.A. Tech. Note, No. 371, April, 1931.) (5.2/21310 U.S.A.)

An aerofoil was constructed with a slot at the point of maximum pressure diminution on the upper surface near the nose, and a distribution of eleven additional slots along the upper surface of the wing, all connected by an internal channel. In principle, air should pass out of the wing at the nose slot and be drawn in at the slots further aft, thereby sucking away the boundary layer. The tests show interesting modifications of the wing characteristics. The maximum lift is reached at  $28^\circ$  incidence with all slots open, at about  $12^\circ$  with slots 2 and 9 closed, and  $15^\circ$  without slots. In the first case the lift and  $L/D$  coefficients are heavily reduced so that stalling occurs at lower speeds, albeit at higher angles of incidence.

Eleven references are given.

*Wing Profiles—Catalogue.* Nos. 226-250. (Services des Recherches de l'Aéronautique, March, 1931.) (5.2/21311 France.)

A further series of twenty-five profiles is given, drawn to scale, with their aerodynamical qualities exhibited graphically and in tables as before. See A. & N. No. 17/20252.

*Extended Theory of Thin Aerofoils: Application to the Biplane Problem.* (C. B. Millikan, N.A.C.A. Report, No. 362, Feb., 1931.) (5.2/21312 U.S.A.)

From Author's summary:—

The aerofoil theory presented in this Paper has been applied to the biplane problem only. It furnishes, however, a general method of attacking the problem of the behaviour of an aerofoil in a disturbed flow, when the disturbing velocities at the aerofoil are known. For this reason it should have a fairly extended range of usefulness. The biplane theory itself is somewhat cumbersome, and the application to particular examples involves rather tedious computations, but it is difficult to see at present how a much simpler theory could be developed for so complex a problem without the introduction of unjustifiable assumptions. The agreement of the present theory with experiment, as indicated in the examples which have been investigated, is in general satisfactory, although considerable discrepancies have been found in certain cases. For the further investigation of these discrepancies it is desirable to have a systematic series of experiments at larger Reynolds numbers.

*Aerodynamic Characteristics of Three Tapered Aerofoils.* (R. F. Anderson, N.A.C.A. Tech. Note, No. 367, Feb., 1931.) (5.2/21313 U.S.A.)

The measurements were made in the variable density wind channel, and the results are given graphically and in numerical tables, in comparison with an aerofoil of rectangular plan under the same conditions. The minimum drag of the

rectangular wing is 20 per cent. less than that of the tapered wing, but with increasing lift the difference becomes less. Lift and drag curves are plotted against incidence and polar diagrams are drawn.

*Gerin Variable Surface Wing.* (L'Aerophile, Vol. XXXVIII, No. 11, 15/2/31, pp. 52-54.) (5.23/21314 France.)

Photographs illustrate the mechanical construction by which the surface of the wing is increased. The method consists of drawing out a rolled up flexible trailing section, somewhat after the manner of a flexible shutter, parallel to the spar. The base of the flexible part is encastré in a slot in the fixed wing, along which it slides.

*Landing Speeds.* (H. F. Ridley, N.A.C.A. Tech. Note, No. 349, Sept., 1930, 60 pp.) (5.1/21315 U.S.A.)

The effect on the coefficient of lift and drag exercised by the reflection of the fixed and trailing vortices in the ground is calculated and the landing speed is deduced. Comparison with experimentally-measured landing speeds of four monoplanes and eight biplanes shows that these corrections are accurate. Each case is worked out numerically.

*Shortening Starting and Landing Runs.* (R. Jaeschke, Z.F.M., Vol. XXII, No. 8, 28/4/31, pp. 221-228.) (5.23/21316 Germany.)

An aeroplane wing of mechanically variable area, increasing the practicable speed range, has been the subject of innumerable patents, and the aim of most constructors since the early days of aviation. No such device has survived the test of experience. The device put forward in the present Paper has the advantage of comparative simplicity of operation without undue sacrifice of structural strength. The outline of the wing profile remains reasonably good. Slight discontinuities on the lower side are formed, but probably have no very serious effect in disturbing the flow. The problem of pulling out the extension of the surface during flight remains to be considered, and only successful operation over a long period can decide its practicability. The problem of placing the ailerons is met by attaching them to a small lower wing of fixed surface.

Polar curves are given of the extended wing alone and of the complete biplane cell; performance diagrams are given with wing contracted and with wing extended. Photographs and diagrams show the experimental machine as built and some of its details.

*Steel Strip Construction.* (W. H. Sayers, Airc. Eng., Vol. III, No. 27, May, 1931, pp. 105-106.) (5.25/21317 Great Britain.)

A review is given of the development of steel construction for wings, particularly of Boulton & Paul's work for the Air Ministry. The necessity for quantity production for economic application is admitted. Expensive riveting is avoided by spot welding. Outline sketches are given exhibiting tubing, flanging, brazing, ribs, and a built-up wing frame.

*Variation of Aileron Hinge Moment with Chord and Span.* (B. H. Monish, N.A.C.A. Report, No. 370, March, 1931.) (5.31/21318 U.S.A.)

The mounting of the models in the wind channel is shown diagrammatically, and the measured results are tabulated numerically and plotted graphically. The hinge moment varies roughly as the span and as the square of the chord.

**Airscrews**

*Adaptation of the Airscrew to the Aeroplane.* (M. Volpert, Tech. Aeron., No. 111, Jan., 1931, pp. 21-25, and No. 113, Mar., 1931, pp. 60-70.) (5.65/21319 France.)

The fitting of a reduction gear between a 700 h.p. engine and the airscrew gained nearly 200 effective horse-power.

The variation of efficiency with various pairs of parameters is exhibited graphically by families of curves.

*An Improved Wooden Airscrew.* (Luftwacht, No. 3, Mar., 1931, p. 138.) (5.652/21320 Germany.)

The wooden airscrew has a fabric covering rendered completely impervious to water, petrol and oil by a special dope. A metal sheath may be attached directly to the fabric over the leading edge without rivets. The new covering allows the use of wood of lower density with a 30 per cent. saving in weight, and prevents warping and corrosion in seaplane work.

**Instruments**

*Neon Lamp Used to Indicate Contact in New Maximum Pressure Indicator.* (Autom. Ind., Vol. LXIV, No. 12, 21/3/31, p. 481.) (6.26/21321 U.S.A.)

An uncooled diaphragm of negligible stiffness brought within  $\frac{1}{8}$  in. of the interior wall of the combustion chamber can be kept sufficiently cool to prevent rupture, and is exposed to cylinder pressure on one side, and on the other side to balancing pressure from an air bottle connected through a control block with a Bourdon spring gauge. A small Neon lamp mounted directly above the gauge indicates maximum pressures. For a multiple cylinder engine a bank of lamps is used, and readings are taken simultaneously showing rapidly variations in operating conditions and giving more consistent results than any other instrument for the determination of maximum cylinder pressures.

**Stability and Control**

*Static Stability.* (M. Guibert, L'Aeron., No. 140, Jan., 1931, pp. 11-19.) (7.2/21322 France.)

The pitching moment of an aeroplane is analysed into its various components. Elementary formulæ are obtained and the graphical representation illustrates at a glance the limit of neutral equilibrium. Graphical methods of application are expounded, and a comparison is made between power flight and gliding flight.

*The Boykow Automatic Pilot.* (Aero. Rev., Vol. VI, No. 8, 15/4/31, p. 116.) (7.5/21323 Switzerland.)

The Boykow automatic pilot, weighing 110 kg., gave satisfaction on the Junkers W. 33 over 100 flying hours. It has been simplified and lightened. The new type, costing approximately £1,500, is undergoing trials on the Junkers W. 34.

*Full-Scale Measurement of Manœuvrability.* (C. H. Dearborn and H. W. Kirschbaum, N.A.C.A. Report, No. 369, March, 1931.) (7.4/21324 U.S.A.)

Air speed, angular velocity, linear acceleration, and control movements were measured during a variety of aerobatic manœuvres. The special instruments mounted were an angular velocity recorder, corrected air speed recorder, recording inclinometer and a timer. In some cases the flight path was recorded by a camera obscura. The results are shown graphically, and some are tabulated numerically. Eleven references are given.

*Landing in Fog.* (R. Schulz, Luftwacht, No. 3, March, 1931, p. 129-134.) (7.8/21325 Germany.)

The radio beacon and receiving system developed by the American Bureau of Standards is described, and is considered as the furthest developed and most effective.

### Engines

*Tatra Engine with Cylindrical Head-Joint.* (Autom. Ind., Vol. LXIV, No. 7, 14/2/31, p. 234.) (8.25/21326 U.S.A.)

Two banks of cylinders at  $60^\circ$ , with the valves of both sets horizontal and operated from the same camshaft at  $60^\circ$  with the cylinder axes, require an unusual form of combustion chamber. The machining problem has been solved by making the joint between the cylinder and head cylindrical. The under surface of the entire head also is cylindrical except for depressions in it directly over the valve heads. The piston comes close up to the cylinder head at the top of the stroke and induces considerable turbulence in the charge near the instant of firing. The cylinder head is of cast aluminium. The cylindrical joint overcomes difficulties due to differences in expansion.

*Heat Transfer through Building Walls.* (M. S. van Dusen and J. L. Finck, Bur. Stan. J. Res., Vol. VI, No. 3, March, 1931, pp. 493-522.) (8.1/21327 U.S.A.)

An elementary physical theory of heat conduction is applied, and coefficients are obtained from tests of slabs of representative materials. These were used to compute the conductivity of walls. It is stated that the error of measurement is less than 5 per cent.

*Calculation of Equilibrium and Temperature Resulting from the Combustion of Carburetted Mixtures.* (P. Montagne, C.R., Vol. CXCII, No. 15, 13/4/31, pp. 882-884.) (8.1/21328 France.)

The authors calculate the combustion temperatures of a series of pentane-oxygen mixtures, making allowance for dissociation of hydrogen. The highest temperature,  $3,820^\circ$  absolute, was obtained with a mixture 20 per cent. rich in combustible.

*Gaseous Explosive Reaction—Effect of Pressure on Rate of Propagation of Reaction Zone and on Rate of Molecular Transformation.* (F. W. Stevens, N.A.C.A. Report, No. 372, Feb., 1931.) (8.10/21329 U.S.A.)

The constant pressure bomb used in studying the effect of pressure on normal burning reaction approaches an ideal experimental engine. The time-volume figures at constant pressure give accurately the work done by a given charge. The experimental results for increasing pressures show that the work done is proportional to pressure, that is, to the concentration of the charge.

Under like conditions the final state of equilibrium is independent of the intermediate stages, and it is desirable to establish a formal mechanism such as has been attempted in the kinetic theory of chain reactions.

Twenty-seven references are given.

*Photographic Flame Studies in the Petrol Engine.* (L. Withrow and T. A. Boyd, Ind. & Eng. Chem., Vol. XXIII, No. 5, May, 1931, pp. 539-547.) (8.13/21330 U.S.A.)

Simultaneous photographs were taken of the pressure rise and flame travel in an engine at constant r.p.m. with different spark settings and fuels. The after-glow confirms observations of Maxwell and Wheeler with a bomb. Knocking occurs when the rate of flame propagation rises from its comparatively low speed



at ignition to a high speed through the unburnt portion of the charge. Tetra-ethyl lead does not affect the initial character of the flame, but postpones or prevents the subsequent rise of flame velocity and the concomitant knock.

Eleven references are given.

*Luminous Stationary Flames: Quantitative Relationship between Flame Dimensions at the Sooting Point and Chemical Composition, with Special Reference to Petroleum Hydrocarbons.* (S. T. Minchin, J. Inst. Petroleum Tech., 1931, 17, 102-120. Chem. & Ind., Vol. L, No. 21, 22/5/31, p. 469.) (8.13/21331 Great Britain.)

The tendency of a kerosene to form smoke is proportional to its aromatic and naphthene content and depends on the boiling range. An equation is derived for the tendency to smoke of any homologous series. It appears that the work could be extended to anti-knock properties of the fuel.

*Ultra-Violet Spectroscopy of Flames of Motor Fuels. Analysis of Gasoline for Iron Carbonyl by Means of a Small Quartz-Prism Spectrograph.* (G. L. Clark, V. R. Hardy and H. B. Willman, J. Phys. Chem., 1930, 34, 1924-1929; Chem. & Ind., Vol. L, No. 21, 22/5/31, p. 469.) (8.13/21332 Great Britain.)

Concentrations as small as  $5 \times 10^7$  grammes of carbonyl per cc. of solution can be detected by the quartz-spectrograph. Several of the iron lines shown have not been previously identified in flames.

*Experiments to Determine Velocities of Flame Propagation in a Side Valve Gasoline Engine.* (J. Inst. Pet. Tech., 16, 756-82 (1930). Chem. Absts., Vol. XXV, No. 7, 10/4/31, p. 1664.) (8.13/21333 Germany.)

The speed of flame propagation was measured stroboscopically and the rate of pressure rise in the combustion chamber was observed. Using combustion heads with different clearances the mean velocity of flame propagation was proportional to the maximum rate of pressure rise which was taken as a measure of the turbulence. The smaller the head clearance the more rapidly the flame speed diminishes after reaching the cylinder surface, where the flame is cooled. The H.U.C.R. was raised for the same reason.

*On the Velocity of Phenomena Due to the Detonation of Solid Explosives.* (P. Laffitte and M. Patry, C.R., Vol. CXCII, No. 12, 23/3/31, pp. 744-746.) (8.13/21334 France.)

In the immediate neighbourhood of an exploding substance the speeds of shock wave and of projected luminous gases are identical. The gas speed diminishes more rapidly than the shock wave speed, so that the two phenomena separate and are propagated independently. Examples for various charge densities of dynamite and tetryl are given.

*Kinetics of Combination of  $H_2$  and  $O_2$ . Influence of Iodine.* (W. L. Garstang and C. N. Hinshelwood, Proc. Roy. Soc., Vol. CXXX, No. A.815, 3/3/31, pp. 640-654.) (8.13/21335 Great Britain.)

The surface reaction in vessel of silica and porcelain is found to be accelerated by the presence of iodine, but the gas reaction at relatively high temperatures and pressures is retarded and explosion within normal pressure limits is inhibited.

*Modern Engine Production.* (J. C. Briggs, Airc. Eng., Vol. III, No. 26, April, 1931, pp. 80-86.) (8.2/21336 Great Britain.)

A detailed technical description is given of the processes of manufacture in the production of Jaguar engines, illustrated by twenty-eight photographs.

*Scavenging and Power Output of Two-Stroke Engine.* (R. Wintterlin, Z.V.D.I., Vol. LXXV, No. 6, 7/2/31, pp. 165-169.) (8.1/21337 Germany.)

The problem is investigated theoretically and the relations obtained between quantity of scavenge air required, pressure, speed of operation, valve area, and stroke volume, indicate the disadvantages of short stroke engines.

*Stress Analysis of Aircraft Engines.* (H. Caminez, Autom. Ind., Vol. LXIV, No. 18, 2/5/31, pp. 696-698.) (8.2/21338 U.S.A.)

The rigidity of a bearing determines its load capacity. The introduction of steel-backed lead-bronze bearing to replace the plastic babbitt metal in common use till 1925 has doubled the permissible rubbing speed.

In radial engines the extra side thrust on the piston brought about by the master rod assembly has to be allowed for when applying single cylinder results.

Torque variation should be specified in all propeller tests.

*Approximate Equations for the Standard Atmosphere.* (W. S. Diehl, N.A.C.A. Report, No. 376, March, 1931.) (8.23/21339 U.S.A.)

A number of empirical functions are tabulated and plotted graphically against an accepted standard curve. These functions have their appropriate application in calculating the effect of height on performance.

*Comparison of Aeroplane Performance.* (J. Kerguistel, L'Aeron., No. 142, March, 1931, pp. 89-92.) (8.23/21340 France.)

An empirical formula is given for variation of engine torque with height, and on this basis a family of curves is drawn from which the ceiling height may be read off. Selecting two convenient parameters twenty-eight results are marked, and illustrate the application of the method. The time of climb is also obtained readily.

*Graphical Determination of Ceiling.* (W. S. Diehl, N.A.C.A. Report, No. 368, March, 1931.) (8.23/21341 U.S.A.)

The usual formulæ for horse-power required are substantially exact. The expression for horse-power available depends on a paper to which only reference is given. The results are plotted in intersecting families of curves which enable the ceiling to be read off from the data of the aeroplane and power plant.

Five references are given.

*Superchargers and Supercharging.* (O. W. Schey, S.A.E. Journal, Vol. XXVIII, No. 5, May, 1931, p. 524-525, also N.A.C.A. Report, No. 384.) (8.235/21342 U.S.A.)

Various types of supercharger are briefly described. Compression efficiency is important. A boost of 5 lbs. per sq. in. produced no perceptible increase in exhaust temperature with a compression ratio of 7.5, and a rise of 100°F. with a compression ratio of 3.5.

*Superchargers.* (L'Aeron., No. 142, March, 1931, pp. 101-109.) (8.235/21343 France.)

A brief general discussion of superchargers is given, with photographs, perspective drawings and sectional arrangement of the Rateau-Farman compressor and mechanical control. Curves and tables of performance are given up to heights of 8,000 metres from two test flights.



*The Oberhansli Four-Cylinder Heavy Oil Engine.* (K. Neumann, Z.V.D.I., Vol. LXXV, No. 15, 11/4/31, pp. 453-455.) (8.25/21344 Germany.)

This engine has two-stage ignition, the ignition chamber being displaced relative to the cylinder axis, with communication through a wide channel shaped to produce turbulence. The Bosch fuel pump is used. Tests on a four-cylinder engine rated 80 h.p. at 1,350 r.p.m., showed mean effective pressure 80 lbs. per sq. in., fuel consumption 45 lbs. per hour, volumetric performance 8.4 h.p. per litre.

*Combustion and Design Problems of Light High-Speed Diesel Engines.* (S.A.E. Journal, Vol. XXVIII, No. 5, May, 1931, p. 565-568.) (8.25/21345 U.S.A.)

The mean effective pressure of an injection engine is reduced by ignition lag, which so far remains too great for high speed operation. The application of boost pressure is promising, provided that the injection system can maintain fuel penetration against the increased pressure.

*Jalbert Heavy Oil Engine.* (W. F. Bradley, Autom. Ind., Vol. LXIV, No. 14, 4/5/31, pp. 548-549.) (8.25/21346 U.S.A.)

The engine has a carburettor which feeds gas oil to a small cylinder mounted on the head of each working cylinder, with a piston driven at half engine speed from the overhead camshaft. Between fuel cylinder and working cylinder is an automatic valve with a small lift of a few hundredths of a millimetre. Experiments on the single cylinder units have given M.E.P.'s of 100 lbs. per sq. inch at 2,000 r.p.m., with oil consumption less than 4 lbs. per brake horsepower.

A six-cylinder engine, bore 125/180 mm., rated at 200 h.p., is being developed by the French Air Service.

*Survey of Mobile Type Diesel Engines.* (C. G. A. Rosen, S.A.E., Vol. XXVIII, No. 3, March, 1931, pp. 301-306.) (8.291/21347 U.S.A.)

To maintain high operative speeds in mobile Diesel engines attention is being diverted to special light fuel oils, whereas the future depends on ability to consume cheap fuel economically. Engines of the Hesselmann type are a compromise, and lose the economic advantage of cheap fuel.

*Effectiveness of Ignition Sparks.* (M. F. Peters, W. L. Summerville and M. Davis, N.A.C.A. Report, No. 359, Nov., 1930, 13 pp.) (8.28/21348 U.S.A.)

The effectiveness of a spark was determined by measuring the volume of hydrogen and oxygen combined by its passage under 2 mm. of mercury absolute pressure. A definite number of sparks was passed and the reaction estimated by the diminution of pressure. In a general way the mass of gas ignited is closely related with the maximum current. Increase of spark intensity increased the mass of gas which reacted.

A bibliography is given.

*Fuel Injection with Spark Ignition in an Otto-Cycle Engine.* (C. F. Taylor, E. S. Taylor and G. L. Williams, S.A.E., Vol. XXVIII, No. 3, March, 1931, p. 345-352.) (8.28/21349 U.S.A.)

A series of tests was run to compare the performance of an engine with the injection of fuel into the inlet pipe, with injection into the cylinder and with a conventional carburettor. The fuel was injected into the inlet pipe during the suction stroke from 30° to 51° after top dead centre.

Fuel injection into the cylinder through the top sparking plug hole was begun at various angles through the range from  $30^\circ$  to  $120^\circ$  after T.D.C. during the suction stroke and lasted for about  $21^\circ$ . The injection valve was designed to give good atomisation and low penetration against substantially atmospheric pressure in the cylinder. Constant engine speed was 1,500 r.p.m., and spark advance was  $28^\circ$ ; compression ratio varied from 3.5 and 5/1.

Injection generally have better power and economy than the carburettor, probably by increase of volumetric efficiency. The fuel economy is most marked with very weak mixtures, such as lead to back fire with a carburettor.

*The Automotive Ignition Coil.* (T. H. Darnell, N.A.C.A. Report, No. 374, April, 1931.) (8.281/21350 U.S.A.)

Measurements on the secondary voltage induced in an ignition coil of typical construction under a variety of operating conditions are in satisfactory agreement with calculated figures.

*Bi-Metal Pistons.* (Dipl. Ing. Mahle, Autom. Tech. Zeit., Vol. XXXIV, No. 9, 31/3/31, pp. 205-208.) (8.32/21351 Germany.)

Pistons with light alloy heads attached to cast iron steel skirts have not been a success. Light alloy pistons with inserts of invar to reduce expansion of the skirt are more promising. The main difficulty is the provision of adequate ring support in the head combined with proper lubrication. The strength of all light alloys diminishes rapidly with temperature, and any measurable blow-past softens the supports sufficiently to allow the rings to hammer. Gas leakage increases and the piston crown finally burns away. The wear in the cylinder barrel is determined primarily by piston ring friction. The rapid wear often associated with light alloy pistons is not due to the lapping action of the alloy as previously held, but to faulty ring lubrication.

*Friedl Air-Cooled Valve.* (Flugsport, Vol. XXIII, No. 8, 15/4/31, p. 166.) (8.32/21352 Germany.)

The hollow exhaust valve has air entry holes in the stem and exit holes near the valve seating. The exhaust pipe of the engine, in the form of a short venturi, faces forward and produces pressure drop near the valve seating which aspires a stream of air through the valve save during the exhaust stroke. The holes are placed so that no exhaust enters the valve. An increase in performance is claimed on a standard Boeing postal aeroplane.

*Colloidal Graphite as Anti-Fur Compound in Radiators.* (O. Steinitz, Autom. Tech. Zeit., Vol. XXXIV, No. 10, 10/4/31, p. 236.) (8.4/21353 Germany.)

A solution of 5 grammes of colloidal graphite in 2 gallons of water has an effective anti-fur action by providing active centres throughout the water for the deposit of lime or other salts, which otherwise would be deposited on the metal surfaces.

*Artificial Ageing of Mineral Oils.* (F. Evers and R. Schmidt, Wiss. Veroffentlich Siemens Konzern 9, No. 1, 357-68 (1930). Chem. Absts., Vol. XXV, No. 8, 20/4/31, p. 1977.) (8.54/21354 Germany.)

The Siemens Konzern has developed an accelerated ageing test for mineral oils which is stated to give a close approximation to the average life of oil in electrical transformers.

*Oil Cooling.* (W. R. Ramsaur, S.A.E. Jrnl., Vol. XXVIII, No. 4, April, 1931, pp. 429-437.) (8.58/21355 U.S.A.)

The effect of temperature in reducing the strength of bearings is discussed and numerical results of experiments are given graphically, an extreme case showing a reduction of 75 per cent. at the boiling point of water. Measured oil temperatures, with and without oil cooling, are also given graphically.

Photographs of two typical oil coolers are given.

*Gasoline and Lubricants by Hydrogenation.* (R. T. Haslam and W. C. Bauer, Oil and Gas J., 29, No. 37, 34, 165, 166 (1931). Chem. Absts., Vol. XXV, No. 8, 20/4/31, p. 1982.) (8.602/21356 U.S.A.)

The anti-knock quality of hydrogenated gasolines, in contrast with cracked fuels, increases with density and their lubricating quality meets all normal requirements. They are sensitive to the addition of lead tetra-ethyl and are generally equivalent to benzine for blending purposes.

*The Use of Alcohol as Fuel in Germany.* (K. R. Dietrich, Autom. Tech. Zeit., Vol. XXXIV, No. 9, 31/3/31, pp. 209-210, and No. 10, 10/4/31, pp. 234-235.) (8.606/21357 Germany.)

An historical sketch is given of the development of alcohol base fuel for motor-cars, which received great impetus during the war. The main difficulty is the provision of an alcohol free from water content. Mixtures containing impure alcohol, though stable, will form deposits in the tanks when replaced by a normal petrol or benzol. Several methods of producing water-free alcohol on the industrial scale are on trial in Germany, and a French process, worked under licence, is apparently the most successful. The fuel is marketed as "monopolin," and contains 20 per cent. absolute alcohol, the rest being petrol or petrol-benzol. Recently each importer of petrol is obliged by law to buy a proportion of absolute alcohol from the Government trust, as in France, where active Government help has established the alcohol industry. Similar fuel mixtures containing alcohol are standardised in Italy and Spain.

*Storage of Carbon Monoxide.* (O. H. Wagner, Brennstoff Chem., 12, 87-9 (1931). Chem. Absts., Vol. XXV, No. 8, 20/4/31, p. 1971.) (8.64/21358 Germany.)

Carbon monoxide is a constituent of coke oven and blast furnace gases, and enormous quantities are wasted yearly. Various methods of storage are investigated. The most promising absorbent substances are the halides and ammoniates of copper, iron, nickel and cobalt. The gas forms an excellent motor fuel either alone or in admixture to reduce detonating of fuel gases rich in hydrogen.

*Presence of Peroxides in the Gases of Explosion Engines.* (Dumanois, Mondain-Monval and Quanquin, C.R., Vol. CXCII, No. 19, 11/5/31, pp. 1158-1160.) (8.640/21359 France.)

A  $1\frac{1}{2}$  h.p. 1,200 r.p.m. air-cooled motor-cycle engine was run under load till the cylinder, covered with asbestos, reached a temperature of 270° C., at which running was continued under auto-ignition for about two minutes with the electric ignition switched off. This is explained by the presence of peroxide formed during the compression stroke, the alternative explanation of a local hot spot being dismissed without comment. Motoring after the cessation of auto-ignition showed aldehydes and other oxidising agents in the exhaust.

*Ultrafiltration of Petroleum.* (A. Zaharia and E. Lucatu, Bul. Soc. Chim. Romania 12, 90-4 (1930). Chem. Absts., Vol. XXV, No. 8, 20/4/31, p. 1977.) (8.64/21360 Italy.)

Filtration experiments with rubber membranes .04 mm. thick under 150 atmospheres indicate that the asphalt in petroleum is colloidal, but the resins and paraffins are in true solution.

*Explosion of Mixtures of Acetylene and Electrolytic Gas.* (W. A. Bone, R. P. Fraser and F. Lake, Proc. Roy. Soc., Vol. CXXXI, No. A.816, 2/4/31, pp. 1-17.) (8.640/21361 Great Britain.)

Successive additions of acetylene to electrolytic gas disturb the uniformity of the initial flame of propagation. It appears that the freshly-formed carbon monoxide is in an excited condition and competes with the free hydrogen present more than can be accounted for by ultimate equilibrium under the law of mass action. There are difficulties in the interpretation of the records which it is hoped to elucidate later.

*Detonation Characteristics of some Aliphatic Olefin Hydrocarbons.* (W. G. Lovell, J. M. Campbell and T. A. Boyd, Ind. & Eng. Chem., Vol. XXIII, No. 5, May, 1931, pp. 555-558.) (8.645/21362 U.S.A.)

The relative tendencies to knock in an engine were measured for 25 olefin hydrocarbons. Differences in knocking tendencies are related to molecular structure. With straight-chain olefins the tendency increases with the length of the longest saturated carbon chain. With branch-chain olefins the knocking depends on the position of the double bond, and on the structure of the branch.

*Knocking in Ignition Engines.* (K. Schnauffer, Z.V.D.I., Vol. LXXV, No. 15, 11/4/31, pp. 455-456.) (8.645/21363 Germany.)

From the change in ionisation of the fuel mixture in an ignition engine during the working cycle at several measuring points, the zone of maximum ionisation can be traced out by oscillograph. Assuming this zone to coincide with the flame front, the latter, under detonating conditions, appears to travel with indefinitely great speed over certain regions of the cylinder, so that knock is set up by the simultaneous ignition of a considerable portion of the charge.

*Knocking in Combustion Engines.* (L. Auer, Autom. Tech. Zeit., Vol. XXXIV, No. 12, 30/4/31, pp. 278-279.) (8.645/21364 Germany.)

By fitting the Midgley pin with a special recording device, both the intensity of the knock and its time of occurrence are recorded on a string galvanometer. Generally the knock is the more intense the nearer it occurs to top dead centre. Maximum knock corresponds to maximum power mixture.

*Knock-Sound Intensity.* (S.A.E., Vol. XXVIII, No. 2, Feb., 1931, p. 256.) (8.645/21365 U.S.A.)

The measurement of knock-sound intensity by microphone and vacuum tube and amplifying set was described in a Paper, S.A.E., "Effect of sound intensity on knock ratings," H. F. Huf, J. R. Sabina, and J. B. Hill, of the Atlantic Refining Co. Widely varying fuels were compared with mixtures of *n*-heptane and iso-octane at knock intensities ranging from incipient knock to an intensity causing pre-ignition. In the L-head Co-operative Fuel Research test engine, intensity does not affect knock ratings in fuel-matching methods.

*Knocking and Effect of Anti-Knock Compounds.* (J. Lorentzen, Z. Angew. Chem. 44, 130-6 (1931). Chem. Absts., Vol. XXV, No. 8, 20/4/31, p. 1978.) (8.645/21366 Germany.)

Knocking begins when incomplete combustion is propagated through the mixture and a pressure wave is reflected from the wall of the containing vessel, causing an explosion of the partly-oxidised products. The first addition of lead tetra-ethyl or iron carbonyl had no effect on combustion. The addition of combustion products of the anti-knock compound was effective in suppressing detonation under certain conditions.

*Detonation Symposium.* (A. L. Clayden, *Autom. Ind.*, Vol. LXIV, No. 5, 31/1/31, pp. 162-164.) (8.645/21367 U.S.A.)

Knock-ratings are affected by spark-timing and mixture ratio. The spark-setting should be that of maximum power with a non-detonating fuel, and the mixture ratio that of maximum detonation. It is essential that the test engine should approximate in size, temperature, and speed of operation to the engine in which the fuel is to be used.

*Dilute and Highly Preheated Mixtures in Carburettor Engines.* (A. Capetti, *L'Aerotecnica*, Vol. XI, No. 3, March, 1931, 255-268.) (8.645/21368 Italy.)

Fuel mixtures were investigated at various throttle openings, with air inlet temperatures up to 120° C. At the higher temperature knocking occurred for weak mixtures. It appears that the most economical method of regulating an engine is by weakening the mixtures below maximum efficiency and then throttling.

*Atomization of Liquids.* (R. A. Castleman, Jr., *Bur. Stan. J. Res.*, Vol. VI, No. 3, March, 1931, pp. 369-376.) (8.701/21369 U.S.A.)

A simplified carburettor, in the form of a thin jet acting vertically downwards from an orifice, was studied. The rate at which the jet broke up into segments, and finally, under surface tension, into spherical drops, was observed by spark photographs and by stroboscope. Two photographs, each representing one case, are reproduced. Rayleigh's theory of subdivision of the jet under surface tension is quoted and is considered a sufficient physical explanation of the results in more complicated circumstances. Four photographs of atomisation of a jet of water in a model calibrated throat are reproduced.

*Coefficients of Discharge of Fuel Injection Nozzles for Compression Ignition Engines.* (A. G. Gelalles, *N.A.C.A. Report*, No. 373, March, 1931.) (8.705/21370 U.S.A.)

The injection pressure and chamber back pressure employed were comparable with those in compression ignition engines during injection. A smooth entrance passage to the throat of the orifice is necessary for high efficiency of discharge. An orifice gives a higher coefficient with a beveled leading edge than with a rounded one. The coefficients of geometrically similar nozzles for different diameters and rates of flow lie on a unicursal curve when plotted against Reynolds numbers.

### *Anti-aircraft Ranging, Etc.*

*Machine-Gun Cooling.* (*Sci. Am.*, April, 1931, p. 264.) (9.11/21371 U.S.A.)

A note quoted from the daily Press states that the use of ethylene glycol in the water jacket doubles the firing capacity of machine guns.

*Anti-Aircraft Methods Applied to Field Guns.* (G. M. Wells, *Army Ord.*, Vol. XI, No. 65, March-April, 1931, pp. 365-370.) (9.77/21372 U.S.A.)

The author is chief of the anti-aircraft section of the Artillery Division of the U.S.A. Ordnance Dept. He discusses the general problem of fire control of anti-aircraft batteries. A diagrammatic chart is given of a complete lay-out for a four-gun battery. Photographs are given of the battery in action, with personnel and equipment, and individual photographs of the director mounted on a motor truck, and an optical range finder, the former with a crew of seven, and the latter with a crew of three.

**Materials**

*Resistance to Heat of Ordinary Steels.* (L. Guillet, J. Galibourg and M. Samsoen, C.R., Vol. CXCII, No. 15, 13/4/31, pp. 861-863.) (10.101/21373 France.)

The elastic properties of a series of commercial steels were measured with an elasticimeter designed by the authors and recording accurately small extensions between 15° C. and 525° C. There is no true elastic limit, even at ordinary temperatures. The apparent permanent set is due to the imperfections and insensitivity of measuring apparatus.

*Method of Testing the Local Element Theory of Corrosion.* (W. Geurtler and B. Blumenthal, Z.f. Metallk., Vol. XXIII, No. 4, April, 1931, p. 118.) (10.125/21374 Germany.)

Apparatus is described for determining the rate of solution of zinc in hydrochloric acid. The possibility of using this method for attacking the general problem is discussed.

*Velocity of Corrosion from the Electrochemical Standpoint.* (U. R. Evans, L. C. Bannister and S. C. Britton, Proc. Roy. Soc., Vol. CXXXI, No. A.817, 1/5/31, pp. 355-375.) (10.125/21375 Great Britain.)

Under conditions favourable for complete tapping of the electric currents flowing between anodic and cathodic portions of corroding metal, the currents measured are equivalent electro-chemically to the corrosion produced. With a single metal the anodic and cathodic areas are determined by differences in oxygen concentration. The electro-chemical factors which determine the strength of this current are the main problem of corrosion. Increasing current reduces the potential difference between cathode and anode by polarisation, but before they are equalised it must reach an equilibrium value which gives the maximum corrosion rate under the particular conditions however low the resistance of the circuit. The current strength cannot be obtained by dividing the apparent electro-chemical potential by the apparent resistance of the circuit.

Polarisation, due to limitation of oxygen supply, occurs generally at the cathodic area. Cathodic polarisation curves, under controlled conditions of oxygen supply, have been traced for a number of metals.

*Corrosion Due to Differences in Potential and its Prevention.* (E. K. O. Schmidt, Z.F.M., Vol. XXII, No. 6, 28/3/31, pp. 177-178.) (10.262/21376 Germany.)

Brass fittings screwed into light alloy parts are liable to corrosion in the thread, which can be prevented by a fibre bush between alloy and brass fitting. Bakelite fittings screwed directly into the light alloy would serve for many purposes and eliminate corrosion troubles.

*Tungsten Carbide Tools in an Automobile Plant.* (Autom. Absts., Vol. IX, No. 5, May, 1931, p. 141.) (10.2/21377 U.S.A.)

Tools of this material are most successfully used in continuous cutting operations, such as turning and boring. They have not yet been generally applied to machining steel.



*A New High Temperature Alloy, "Konel."* (Z. Metallk., Vol. XXIII, No. 3, March, 1931, p. 86.) (10.23/21378 Germany.)

The alloy has the following composition:—

Ni.	70	per cent.
Co.	19.5	" "
Fe.	7.4	" "
Ti.	2.8	" "
—		
	99.7	" "

It maintains tensile strength up to high temperatures, 42 kg/mm<sup>2</sup> at 600° C., more than double that of chrome-nickel steel. It finds extensive use in radio valves as a substitute for platinum.

*Thermal Conductivity of Krypton.* (Z.V.D.I., Vol. LXXV, No. 13, 28/3/31, p. 405.) (10.230/21379 Germany.)

The coefficient of thermal conductivity of Krypton is  $1.9 \times 10^{-5}$  Cal/cm.sec. at 0° C., the lowest yet determined. Xenon should have a still lower coefficient on account of its higher molecular weight.

The coefficients of CO<sub>2</sub> and of hydrogen are respectively about thrice and thirty times as great.

*Protection of Aluminium Alloys.* (P. M. Haenni, L'Aeron., No. 140, Jan., 1931, pp. 32-33.) (10.231/21380 France.)

A summary is given of the literature, particularly with reference to alclad. Micro-photographs show a specimen of alclad in which the pure aluminium surface sheet is 1.3 mm. thick. A photograph of a section of two alclad sheets, taken through the central line of the rivet, shows the protection afforded to the latter.

*Treatment of Commercial Aluminium and Aluminium Alloys with Cl<sub>2</sub> and N<sub>2</sub>.* (W. Koch, Z. Metallk., Vol. XXIII, No. 3, March, 1931, pp. 95-96.) (10.231/21381 Germany.)

The treatment with gas improves the structure of the alloy, containing not less than 95 per cent. Al. The castings are rendered more homogeneous, the surface is smoother, and subsequent machining is easier.

*Repairs to Aluminium Parts by Means of "Tialit."* (Burkhard, Aero. Rev., Vol. VI, No. 10, 15/5/31, pp. 138-140.) (10.284/21382 Switzerland.)

A new aluminium solder "Tialit," worked by a coal gas flame at a temperature not exceeding 400° C., is stated to have been in satisfactory use for some years by the Swiss Air Force, mainly for aluminium crankcase repairs.

*X-Ray Investigations of Cold Treatment of Duralumin.* (J. Hengstenberg and G. Wasserman, Z. fur Metallk., Vol. XXIII, No. 4, April, 1931, pp. 114-117.) (10.231/21383 Germany.)

The method of Debye-Scherrer indicates that the cold working of duralumin slightly increases concentration of copper atoms within the aluminium lattice, but forms no new crystals.

*Fire-Resisting Qualities of Timber.* (W. Jacobsohn, Z.V.D.I., Vol. LXXV, No. 14, 4/4/31, pp. 424-425.) (10.4/21384 Germany.)

A number of substances render impregnated wood more or less fire-resisting. Acetic acid and alum were known to the Romans. The effectiveness is measured by changes in weight of a specimen while exposed to a flame, and subsequently

after the flame has been removed. Two per cent. dyamonium phosphate was insufficient to prevent spread of burning. Above 12 per cent. there was no increase in fire-resisting qualities.

*Red and White Heart Beech, Strength Tests.* (E. Gaber and H. Hoeffigen, Z.V.D.I., Vol. LXXV, No. 14, 4/4/31, pp. 421-424.) (10.4/21385 Germany.)

Under similar test conditions the strength of beech with red-wood core is 20 per cent. less than beech with white-wood core.

*Air Permeability of Fabrics.* (H. F. Scheifer and A. S. Best, Bur. Stan. J. Res., Vol. VI, No. 1, Jan., 1931, pp. 51-58.) (10.424/21386 U.S.A.)

Air is drawn through a known area of fabric and through a calibrated orifice meter. A photograph and a sectional diagram of the instruments are given and a number of typical permeability curves are tabulated and plotted showing flow against pressure.

### Wind Tunnels

*Design of Compressed Air Tunnel at N.P.L.* (A. J. Grant, Airc. Eng., Vol. III, No. 26, April, 1931, pp. 93-96.) (11.1/21387 Great Britain.)

The most impressive technical difficulty arose from the supply of the external steel drum, in round figures 17 feet internal diameter, 6 inches thick and 45 feet long. Another difficulty lay in the design of joints to prevent leakage under working pressures of 30 atmospheres and test pressures of 100 atmospheres.

*Airscrew Fans.* (P. S. Ballif and H. L. Dryden, Bur. Stan. J. Res., Vol. VI, No. 3, March, 1931, pp. 387-399.) (11.1/21388 U.S.A.)

In continuation of a previous article (see A. & N. No. 17/20334), a number of test measurements on a 2-blade fan are given in tables and graphically. Two photographs of the installation are given, and the geometry of the fan is specified in dimensioned figures and tables. Comparison is made between the 2-blade and 4-blade fans by means of characteristic curves.

*Development of a High-Speed Wind Channel for Research in External Ballistics.* (Sir T. E. Stanton, Proc. Roy. Soc., Vol. CXXXI, No. A.816, 2/4/31, pp. 122-132.) (11.1/21389 Great Britain.)

An account is given of the preliminary work carried out with a view to designing a high speed wind channel for measuring the resistance of projectiles at speeds above that of sound. Different patterns of sound waves are formed (see abstract No. 21412 of this issue), and corresponding effects on pitot determinations of dynamic pressure were observed. The introduction of an obstacle such as a model of a projectile disturbs the flow in a somewhat indeterminate manner as might be expected. Further investigations will be carried out.

*An Integrating Manometer for Use in Wind Tunnel Distribution Measurements.* (R. W. Noyes, N.A.C.A. Tech. Note, No. 377, May, 1931.) (6.251/21390 U.S.A.)

A multiple manometer designed at the Langley Memorial Aeronautical Laboratory integrates automatically the normal force over the aerofoil section. A description and mathematical theory are given.

### Methods of Test

*Detection of Flaws in Castings by Radium.* (R. F. Mehl, Sci. Am., April, 1931, pp. 242-245.) (11.40/21391 U.S.A.)

Photographs of castings and radiographs exhibiting flaws are reproduced. A number of technical details are given.

*X-Rays in the Steel Industry.* (H. H. Lester, of Watertown Arsenal, J. Franklin Inst., Vol. CCXI, No. 5, May, 1931, pp. 567-599. Released by Ordnance Dept., U.S. Army.) (11.47/21392 U.S.A.)

A brief account is given of recent developments in X-ray examination of steel specimens. Three photographs of flaws in cast steel are reproduced. The specimens were  $8\frac{1}{2}$  cm. thick, the potential on the X-ray tube being about 250,000 volts. Reference is made to a new tube designed for 900,000 volts.

As an alternative method gamma rays from radium have been used successfully to determine serious defects in steel specimens 25 cm. thick.

### Airships

*American Naval Airship.* (Sci. Am., Vol. CXLIV, No. 5, May, 1931, pp. 297-300.) (12.3/21393 U.S.A.)

A descriptive account is given with a number of technical details of the new Goodyear airship. Comparative figures of the Graf Zeppelin and Los Angeles are tabulated. Photographs, sketches and diagrams exhibit the frame work, the completed hull with part of the fabric, and the arrangement of the outrigger mounting of one of the eight swivelling airscrews with the engine inside the hull.

*R.100, Canadian Flight.* (N. S. Norway, J.R.Aer.Soc., Vol. XXXV, No. 245, May, 1931, pp. 401-414.) (12.30/21394 Great Britain.)

The journal was written during the cruise by the author, who is Chief Engineer of the Airship Guarantee Co., Ltd. It is chiefly operational, but some technical details are included.

### Wireless

*Correlation of Radio Reception with Position of the Moon.* (H. T. Stetson, Terrestrial Magnetism, Vol. XXXVI, No. 1, March, 1931, pp. 1-5.) (13.1/21395 U.S.A.)

The mean strength of signals for each hour-angle of the moon is plotted, and definite signs of correlation are found. The varying signal strengths are interpreted as variations in height of the ionized layer. The curve of strength is also transformed and plotted against the moon's altitude and exhibits, as was expected, a still greater effect. A diagram exhibiting the electrical field between earth and moon at different electrostatic potentials illustrates the theory put forward of the change in height of the ionized layer under the influence of the field.

*Some Methods of Measuring the Frequency of Short Waves.* (H. Mogel, Proc. Inst. Rad. Eng., Vol. XIX, No. 2, Feb., 1931, pp. 195-213.) (13.3/21396 U.S.A.)

Author's summary:

Four methods are given for practical frequency measurements on short waves (10-50 metres 30,000-6,000 kc.) with an absolute accuracy of  $\pm 0.01$  per cent. to  $\pm 0.001$  per cent. and a relative accuracy of  $\pm 0.0001$  per cent. Harmonic overtones are used in each method. The frequency standards are luminous quartz resonators developed by Giebe and Scheibe, which are secondary standards constant to 1/100,000, so that continuous supervision with special calibration apparatus and chronograph is unnecessary. The indirect methods use fixed or variable fundamental frequency, while the direct methods use resonators whose response is indicated visually or acoustically. The methods were developed by Transradio A. G. Berlin, and are applied at the transmitting and receiving station at Nauen and Geltow-Beelitz.

Photographs of the apparatus, diagrams of connections, tabulated results, and eighteen references are given.

*Short-Wave Radio Telephony.* (Engineer, No. 3926, 10/5/31, p. 413.) (13.31/21397 Great Britain.)

The International Telephone and Telegraph Co., Hendon, in co-operation with Le Material Telephonique, Paris, staged a cross-Channel test from Dover to Calais of two-way radio telephone communication on wave-lengths varying from 10 to 100 cm. A "micro-radion" tube generates the high frequency oscillations and is connected to a doublet radiating system. The doublet is at the centre of a hemispherical reflector of about 45 cm. diameter and at the focus of a parabolic reflector, the segment of the latter being 3 m. diameter, the quarter latus-rectum being (from the sketch) roughly one metre. The parabolic reflector faces the line of transmission, the hemispheric reflector in the opposite direction. The radius of the latter is selected so that reflected and direct rays from the doublet are in phase when they fall upon the parabolic reflector. A transmitter and receiver of this type are required at each end, and are placed 80 yards apart to avoid coupling.

Two-way conversations were carried on and heard by members of an invited party.

*Monitoring the Operation of Short-Wave Transmitters.* (H. Mogel, Proc. Inst. Rad. Eng., Vol. XIX, No. 2, Feb., 1931, pp. 214-232.) (13.31/21398 U.S.A.)

From author's summary :

A discussion is given of methods of monitoring the variations in the radiated high-frequency energy which occur in the operation of short-wave transmitters from five years' experience of the great Nauen station in overseas wireless communication.

Oscillograms are reproduced illustrating the faults detected in the usual curves.

*Measurements of a Short-Wave Directive Antenna at Nauen.* (M. Baumler, K. Kruger, H. Plendl and W. Pfitzer, Proc. Inst. Rad. Eng., Vol. XIX, No. 5, May, 1931, pp. 812-823.) (13.31/21399 U.S.A.)

In addition to the ground measurements, of which the results are given graphically, observations were made from an all-metal Junkers enclosed cabin monoplane. The work was restricted by the necessity of flying at high altitudes in reasonably calm weather. The calculated and observed horizontal characteristics agree very satisfactorily. The vertical characteristics were calculated both for a non-reflecting earth and a perfectly reflecting earth, and the latter agree well with the observed values, indicating complete reflection in the neighbourhood of the Nauen station. In general the radiated energy is concentrated in the desired direction, both vertically and horizontally. The standard equations of radiation characteristics are collected and tabulated.

*Horizontal Radiation Characteristic of a Short-Wave Directional Aerial with Coupled Reflector.* (K. Kruger and H. Plendl, Z.H.F.T., Vol. XXXVII, No. 4, April, 1931, pp. 142-145, 212th D.V.L. Report.) (13.6/21400 Germany.)

The station was built by Telefunken for communication with New York, and the directional properties were investigated with a di-pole receiver fitted to Junkers F. 13 aeroplane. A station for the Japanese service had been tested in a similar manner. The Japanese station with a reflector coupled by radiation had a backward radiation of 15 per cent. The American station with a directly fed reflector had a backward radiation of only 5 per cent.

*Diversity Receiving System for Radiotelegraphy.* (H. H. Beverage and H. O. Peterson, Proc. Inst. Rad. Eng., Vol. XIX, No. 4, April, 1931, pp. 531-561.)

*Diversity Receiving System for Radiotelephony.* (H. O. Peterson, H. H. Beverage and J. B. Moore, pp. 562-584.) (13.32/21401 U.S.A.)

The first paper describes the application by R.C.A. Communications Inc. of the diversity principle to radio telegraphy and the second to radio telephony. The diversity principle is based on the fact that fading does not occur simultaneously on (a) parallel channels at different frequencies, (b) antennæ of different polarisations of the same frequency, (c) on antennæ of the same polarisation of the same frequency separated in space.

Diagrams of connections, photographs of the installation and records showing the separate and combined strength of three receivers are reproduced. The radio telegraph system has been in successful operation for some years. The application to radio telephony appears to be in a more experimental stage, but the results are promising.

*Visual Studies of Radio Fading.* (E. Merritt, T. Mclean and W. E. Bostwick, J. Franklin Inst., Vol. CCXI, No. 5, May, 1931, pp. 539-566.) (13.32/21402 U.S.A.)

The carrier wave, or an equivalent audible heterodyne, maintaining the amplitude and phase relations of the original signal as picked up by two directional antennæ at right angles has the two components placed upon the deflector plates of a cathode ray oscilloscope tube. The electron beam combines the two components and produces on a fluorescent screen a visible oscillogram.

Rapid fluctuations of the components render it difficult to obtain satisfactory photographic records, and this difficulty is partially met by drawing from sketches, which vary from a circle through a series of ellipses shrinking to a straight line as the limit of a flat ellipse when one component is small, or to a conjugate point when both components are small. The direction of the sending station is not necessarily along the minor axis, so that precautions must be taken in deducing it. The diurnal variations are discussed, and some attempt is made at classification. Further experiments will be carried out.

*Increase of the Effective Height of Trailing Aerials.* (F. Eisner, G. Sudeck, R. Schroder and O. Zinke, L.F.F., Vol. VIII, No. 6, 3/3/31, pp. 141-159, 207th D.V.L. Report.) (13.4/21403 Germany.)

The D.V.L. have brought out a new form of trailing aerial with four times the effective height and three times the metre-ampere number of an ordinary aerial.

*Some Measurements of a Loud Speaker in Vacuo.* (P. K. Turner, J.I.E.E., Vol. LXIX, No. 413, May, 1931, pp. 591-562.) (13.32/21404 Great Britain.)

In order to separate the electrical and mechanical characteristics of a loud-speaker a method was devised of testing it *in vacuo*. It was tested under normal conditions and with the diaphragm sand-loaded to a hundred times its normal inertia. The reactance was observed as a function of frequency under these three conditions, and the difference of the co-ordinates is held to separate the effects of acoustic loading. A mathematical theory of equivalent circuits is worked out and appears to sustain the results. In spite of some criticism as to the equivalence of the circuits introduced in the mathematical theory the method appears to offer new information, and in fact has been found by the author to have been previously applied in the laboratories of the General Electric Company of America.

*Visible and Invisible Ultra Red Rays, with Applications to Communications and Safeguarding Traffic.* (R. Seeliger, Phys. Zeit., Vol. XXXII, No. 5, 1/3/31, pp. 193-212.) (13.5/21405 Germany.)

Improvements in the reception apparatus and the introduction of the amplifying valve have produced types of optical telephony which are capable of competing with wireless apparatus under certain conditions. The article covers the various types of instruments required. A receiver responding quickly to long waves in thermal radiation work is urgently needed. A complete bibliography, with 72 references, is attached.

*Automatic Records of Signals from a Rotating Beacon.* (R. L. Smith-Rose and H. A. Thomas, J. Sci. Insts., Vol. VIII, No. 3, March, 1931, pp. 81-88.) (13.6/21406 Great Britain.)

From author's summary:

A drum is arranged to rotate once a minute synchronously with the beacon by means of a phonic motor with tuning fork control, while a pen is moved transversely so that the trace is a spiral line which is interrupted by the Morse code and navigation signals emitted by the beacon, and by the occurrence of the signal minimum at the receiver. The results of a number of tests carried out with the recorder at a distance of over 90 miles from the beacon show that, under normal conditions, the difference in bearing given by the recorder and by an observer using the aural signal in a pair of telephones is less than  $0.5^\circ$ . The recorder has been used for studying the performance of a rotating beacon, and when suitably developed for the purpose will probably have an application on board ship. For this purpose it may be stated from the tests already made that the apparatus will have a reliable working range of nearly 200 miles with the present type of rotating beacon.

*Orfordness Rotating Beacon.* (R. L. Smith-Rose, J.I.E.E., Vol. LXIX, No. 412, April, 1931, pp. 523-532.) (13.6/21407 Great Britain.)

From author's abstract:

The Orfordness rotating-loop beacon on a wave-frequency of 288.5 kilo-cycles per sec. (wave-length 1,040 m.) emits continuous navigation signals with special Morse characters to indicate N. and E. signal positions. The results submitted by about 160 ships are discussed in detail. Within a range of the order of 100 miles, under favourable conditions, about 80 per cent. of the observed bearings are correct to within  $2^\circ$ .

*A New Type of Photo-Electric Cell Using Selenium with a Rectifying Layer.* (L. Bergmann, Phys. Zeit., Vol. XXXII, No. 7, 1/4/31, pp. 286-288.) (13.7/21408 Germany.)

A photo-electric cell, recently described, consisting of a layer of copper oxide between plates of copper, does not require a vacuum nor initial potential difference. A layer of selenium between lead and iron foils is more sensitive, and, on illumination by a five amp. arc lamp, the photo-electric current drove a small motor. The cells, when subjected to initial voltages, produce currents of 150 milliamps. Experiments on temperature effects are being carried out.

### Photography

*Apparatus for Developing Aerial Photographs for Survey Purposes.* (W. Oehlerking, H. Krauss and A. Griesbach, Z. Instrum., Vol. LI, No. 4, April, 1931, pp. 205-207.) (14.14/21409 Germany.)

Automatic developing machines described, enable the pilot, after a survey flight, to obtain rapidly an idea of the results and to decide whether further flights will be necessary to cover the field.



*Photogrammetry and Aero Photography.* (R. Hegershoff, Vol. VII of a Handbook of Scientific and Applied Photography.) (14.4/21410 Germany.)

The book covers the present position of photogrammetry, which has received considerable post-war development. A large number of instruments are described and illustrated with photographs and diagrams, and the geometrical theory is worked out. The author includes instruments designed to his own specification, concluding with an integrating course indicator which lays off the actual course covered at true ground speed, subject, of course, to errors in the corrections for wind speed. Composite photographs of surface areas are reproduced in illustration, along with maps based thereon. The print, diagrams, and paper are of high quality.

### Acoustics

*Effect of Change of State from Solid to Liquid on the Speed of Sound Transmission.* (Z.V.D.I., Vol. LXXV, No. 13, 28/3/31, p. 398.) (15.20/21411 Germany.)

The sensitivity of the human ear to small changes in direction of sound sources is utilised to estimate the velocity of sound in bodies. On solidification the velocity of transmitted sound is practically doubled. An exception is bismuth, for which the change is smaller.

*Production of Acoustic Waves by an Air Jet above Velocity of Sound.* (Dr. J. Hartmann, Professor of Tech. Physics, R. Tech. College, Copenhagen; Phil. Mag., Vol. XI, No. 72, April, 1931, pp. 926-948.) (15.2/21412 Great Britain.)

The results of previous Papers are reviewed.

The air jet is discharged from a nozzle with a sharp edge, formed by a plane surface externally and a rather flat conical surface internally.

When the internal pressure exceeds 1.9 atm. and the jet is emitted into the free atmosphere a speed exceeding that of sound is attained.

If the internal pressure is from 3 to 5 atmospheres, the external pressure remaining at 1 atmosphere, the jet forms a series of pressure waves, which may be stationary. When the axial velocity range is explored with a pitot tube a damped sinusoidal curve of pressure is obtained. Utilising the variable refractive index, photographs of the density waves were obtained, of which 52 are reproduced.

Determination of stationary waves was made with a resonator, the mouth of which was placed axially in a stream, and further experiments with two jets impinging axially. Determinations of dynamic pressure were made with seven different types of pitot head, and apparent differences in the readings were reconciled by appropriate choice of the initial point. These and other results are given in numerical tables and graphically. (See abstract No. 21389 of this issue.)

*A Simple Theory of Acoustic Filters.* (E. J. Irons, J. Sci. Insts., Vol. VIII, No. 3, March, 1931, pp. 89-93.) (15.38/21413 Great Britain.)

A useful elementary theory of acoustic filters is given with worked out examples showing reasonable agreement with observation.

### Fire Prevention

*Prevention and Extinction of Fires—Conclusion of 216th D.V.L. Report.* (F. Kuhn, Z.F.M., Vol. XXII, No. 8, 28/4/31, pp. 241-244.) (16.05/21414 Germany.)

The application of extinguishers is considered in detail. Various types of chemical extinguishers are specified, and drawings show several types of hand sprinkler and of automatic sprinkler, with a number of fixed nozzles directed

towards the most effective points for extinguishing the flames from the carburettor or from broken connections in the power plant.

### **Helicopters**

*Autogyro Rotor System.* (J. S. Pecker, *Auto. Ind.*, Vol. LXIV, No. 19, 9/5/31, pp. 732-734.) (17/21415 U.S.A.)

The American Autogyro Co. manufacture the rotating unit without blades, but including hub, articulation joints, transmission gear and pylon, and a mechanical starter transmitting up to 40 h.p. A powerful brake stops the rotating blades within 30 seconds after landing.

### **Deck Flying**

*Deck Flying.* (W. R. D. Acland, *J.R.Aer.Soc.*, Vol. XXXV, No. 245, May, 1931, pp. 372-400.) (18.3/21416 Great Britain.)

Deck landing is discussed from an operational point of view and illustrated with numerous photographs. Some of the technical problems are stated and discussed, particularly the air eddies thrown off by the seaplane carrier itself.

### **Matters affecting Pilots**

*Measuring Bodily Steadiness.* (*S.A.E. Jrnl.*, Vol. XXVIII, No. 5, May, 1931, p. 580.) (19.29/21417 U.S.A.)

The individual under test stands on a platform and his want of steadiness is recorded in two planes at right angles. Calibration of the recording instrument against physiological tests gives consistent results and would permit its application to determining the physical condition of pilots before and after flight.

*High Altitude Flying.* (C. J. Stewart, *Airc. Eng.*, Vol. III, No. 26, April, 1931, pp. 87-92.) (19.3/21418 Great Britain.)

The physical and physiological effects of reduced atmospheric pressure are described. The apparatus for the supply of the additional oxygen necessary is fully described and illustrated, and many technical points are discussed.

The drop of temperature requires the supply of additional heat, both to avoid the numbing of the pilot and the frosting of his glasses. The alternative methods of warming the pilot's clothing or of warming the air in the cockpit are described and illustrated. The application of the high altitude chamber is discussed.

*Variation of Pressure in a Closed Cabin during Flight.* (M. N. Gough, *N.A.C.A. Tech. Note*, No. 368, March, 1931.) (19.2/21419 U.S.A.)

A photograph and a dimensioned sketch give details of the cabin and windows. The maximum depression was 5.3 mb., equivalent to about 50 m. difference of altitude at sea level. The variation of the cabin pressure with speed is plotted graphically for various conditions produced by opening different windows.

### **Aerodynamics and Hydrodynamics**

*On Oberbeck's Vortices.* (Banarji and Barave, *Phil. Mag.*, Vol. XI, No. 73, May, 1931, pp. 1057-1081.) (22.1/21420 Great Britain.)

Following Oberbeck (1877) and Reusch (1860) a study is made of the formation of ring vortices by ejection of fluid from a cylindrical tube into a surrounding mass of the same fluid.

A number of photographs is reproduced.

The attempt at a mathematical solution of the equations of viscous fluid motion is based on simplifying assumptions for which no physical reason is vouchsafed.

The solution obtained for a vortex pair in two dimensions appears to represent the motion of a vortex ring in three dimensions in a qualitative manner. A similar result might be obtained more simply by writing down the equations of motion of a vortex pair and introducing empirical factors involving time to produce the observed slight departures from steady motion.

*Viscous Flow and Surface Films.* (R. Bulkley, Bur. Stan. J. Res., Vol. VI, No. 1, Jan., 1931, pp. 89-112.) (22.1/21421 U.S.A.)

An attempt was made to observe departures from Poiseuille flow in capillary tubes on the basis of the formation of a finite layer in contact with the surface, subject to special molecular forces from their proximity to the material of the tube. The results were negative so that the bulk viscosity cannot be altered by molecular forces at the boundary in a depth of greater order than  $2.5 \times 10^{-6}$  cm.

*Vibration of Cylinders in a Stream.* (P. Dupin, C.R., Vol. CXCI, No. 12, 22/9/30, pp. 482-484.) (22.10/21422 France.)

The method of determining the periodicity of alternate vortices shed by a cylindrical obstacle was applied experimentally, and the frequency of oscillation plotted against the stream velocity in two cases. Five zones were observed:—

- (1) Steady vibrations, periods of cylinder and vortices different;
- (2) Irregular vibrations;
- (3) Steady vibrations, periods of cylinder and vortices equal;
- (4) Irregular periods;
- (5) Period of vortices smaller than period of cylinder; period of cylinder diminishing and amplitude vanishing at a determinate value. Near the latter value the period of the cylinder approaches its free period in air.

*Vibration of Cylindrical Rods in Water under the Influence of Alternating Eddies.* (P. Dupin and E. Crausse, C.R., Vol. CXCII, No. 12, 23/3/31, pp. 729-731.) (22.4/21423 France.)

The oscillations of a cylinder in a current accompanied by the shedding of alternate vortices was examined, and the periods and amplitudes of the vibrations are given graphically as functions of the stream velocity.

### Miscellaneous Unclassified

*Dynamics of Rainfall.* (F. Ahlborn, Phys. Zeit., Vol. XXXII, No. 3, 1/2/31, pp. 139-147.) (22.1/21424 Germany.)

A descriptive account is given of the motion set up by a drop falling into a mass of fluid. The internal circulation in the interior of a drop due to surface friction of the air is simulated by admitting jets of fluid to a cylindrical vessel at various angles. The process of the drop falling into water is illustrated by careful sketches, probably based on photographs such as those reproduced in Worthington's "Splashes."

*New Apparatus for Describing Curves.* (Ing. St. Jellinek, Z. Instrum., Vol. LI, No. 4, April, 1931, pp. 187-197.) (0/21425 Germany.)

Twelve instruments are described for the mechanical production of various conic sections and one for the evolute of circles.

*Strength Tests on Paper Cylinders in Compression, Bending and Shear.* (R. V. Rhode and E. E. Lundquist, N.A.C.A. Tech. Note, No. 370, April, 1931.) (0/21426 U.S.A.)

Preliminary tests were made on sheet metal circular cylinders of various diameters and axial lengths. Crushing tests were made on twenty-six paper cylinders with a view to obtaining qualitative ideas as to the type of buckling

failure and the ultimate buckling strength. Photographs are shown of the apparatus, which is simple, and of the twenty-six paper cylinders after collapse. The results are plotted and compared with Wagner's formulæ (N.A.C.A. Tech. Memo. No. 490, 1928), with which they can be brought into approximate agreement by selection of coefficients. The usual rules for buckling strength are formed.

*Photo-Electric Method for Determination of Turgidity of Fluids.* (P. Jakuschoff, Z.V.D.I., Vol. LXXV, No. 14, 4/4/31, pp. 426-428.) (0/21427 Germany.)

The photo-electric cell renders possible the automatic registration of small changes in light intensity, as a measure of (*e.g.*) salt content of sea water, suspended matter in drinking water, pollution of river waters, etc.

*The Question of Air Defence.* (R. Roskoten, Luftwacht, No. 3, March, 1931, pp. 104-112.) (0/21428 Germany.)

A comprehensive discussion is given of the air defence of Germany. The effect of gas bombs, explosive bombs, and incendiary bombs is generally exaggerated. Suitable precautions can reduce or prevent damage, but preparation and education of the civil population is required. The cost is small compared with obtainable results and propaganda on these lines is desirable.

*German Air Estimates.* (A. Kirschner, Luftwacht, No. 2, Feb., 1931, pp. 49-53.) (0/21429 Germany.)

The following items appear in the German budget for 1931 :—

1. Central office for Insurance.
2. Technical Development.
3. Commercial Development.
4. D.V.L.
5. Special Scientific Research.
6. Promotion of civil air transport by Lufthansa.
7. Weather service.
8. Training of personnel (schools for commercial pilots).
9. Lighting and safety equipment of night routes.
10. Completion of air chart of Germany, and of the instructional handbook.
11. Gliding.
12. Assistance for technical publications.
13. Competitions: support for college associations.
14. Free balloons.
15. Contributions to collection of air equipment.
16. Airship development.
17. Airport development.
18. New equipment for distant signal services.
19. Development of laboratories.
20. Development of night lighting.
21. Paying off loans to Lufthansa.

*Engineering Testimony before Official Bodies.* (E. H. Felix, Proc. Inst. Rad. Eng., Vol. XIX, No. 5, May, 1931, pp. 851-855.) (0/21430 U.S.A.)

Author's summary :—

This paper discusses the requirements for the effective presentation of testimony on engineering subjects. The most important qualifications of a witness on technical matters are :—

- (1) The ability to present technical facts in lay language such that persons without technical training and unfamiliar with the technical terms of the profession are able to grasp the significance of his evidence.

- (2) The ability to support every important statement of opinion by an appropriate analogy or citation of recognised authority.
- (3) The ability to qualify himself as an expert by a statement of experience bearing directly on the points to which he testifies.
- (4) The ability to present his evidence without too much reliance on counsel for guidance.
- (5) The ability to testify fearlessly to the truth regardless of how it may affect the outcome of the case or the interests of those who employ him.

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## REVIEWS

### *The Book of the Autogiro*

C. J. Sanders & A. H. Rawson. Sir Isaac Pitman & Sons, Ltd. 5/- net.

The autogiro has caused and is still causing considerable heart-burning among orthodox designers. Many have, undoubtedly, the knowledge that here is the type of aeroplane which will ultimately make people really air-minded.

The publishers have very rightly fixed the price of the book as low as possible. The interest in the autogiro is spreading as the interest in any stable aircraft must spread which has a safe landing speed, which is easy to learn to fly, and which is to all intents and purposes fool proof.

The Book of the Autogiro has been written by Mr. Sanders who has been in charge of the design staff under Senor de la Cierva, and Mr. Rawson, the autogiro test pilot. Two more experienced authors could not have been chosen, and they have written a book of great value.

The future of aviation lies in the hands of that much maligned individual the man in the street. Its prosperity does not entirely depend upon the number of aircraft built for the Royal Air Force, nor upon the aircraft supplied to the air transport companies, though there are many who look upon the Air Ministry as the Milky Way of Aviation. But it will be those who enter the market of civil aviation who will reap the real harvest. There is an earnest desire to fly in the generation now growing up, and this desire can only be fostered by the provision in the first place of the slow landing aeroplane, the aeroplane which is easy to fly.

To make the claim that the autogiro will be the only one of that required class is absurd, and the authors do not do so. But they are right in quoting Thomas Edison who said, after seeing one demonstrated: "These machines are the answer to the needs of aviation, and of those people who have always wanted to fly, but have been afraid. It seems to me that they are the greatest advance made since the Wrights."

The Book of the Autogiro is one for which there will be a steadily increasing demand, for within its covers one is told not only all about the machine, but how to fly it, and the increasing popularity of the autogiro is one of the few certain things in aviation.

### *The Elementary Theory of the Internal-Combustion Engine*

F. W. Ludlam. Blackie & Son, Ltd. 86 p. 8vo. 3/6.

The preface states that the book is intended for engineering apprentices and others who are commencing a serious study of the internal combustion engine and who are not too well equipped mathematically.

As an elementary introduction the book fills the need for a very simple and interestingly written explanation of the subject. Two chapters are devoted to