ABSTRACTS AND NOTICES FROM THE SCIENTIFIC AND TECHNICAL PRESS

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AIRCRAFT ENGINES, FUELS AND LUBRICANTS

1   Fuels and Lubricants (Characteristics and Production)

Comparison of fuels by Analytical and Engine Tests.   D. R. Stephens and S. P. Marley, Ind. and Eng. Chem., Vol. 19, No. 2.   (8.51/5556 U.S.A.)

Eighteen samples of petrol composed entirely of petroleum have been analysed for their content of paraffins, naphthenes, aromatics and any saturated hydro-carbons by the method recently described by Egloff and Morrell. These fuels were then tested for detonating tendency using a direct reading detonation indicator.

Comparison of the benzine equivalents calculated from analysis with those determined by engine tests gave moderate agreement for about half the fuels studied, but there were wide discrepancies.

The Composition of Petrol as indicated by Close Fractionation.   (J. B. Hill, L. M. Henderson and S. W. Ferris, Ind. and Eng. Chem., Jan., 1927. Abstracted in J. Inst. Pet. Tech., Feb., 1927.)   (8.51/5559 U.S.A.)

Four fuels of known history and origin were fractionated by means of a 5ft. Snyder column with a controlled reflux. Fractions consisting of 2.5 per cent. of the total charge were collected and the sp. gr., critical solution temperature in aniline, refractive index and A.S.T.M. distillation of each were determined. Thus graphs were plotted of the boiling-point at 50 per cent. distillate against sp. gr., refractive index and aniline point.

The curves so obtained show a surprising regularity of peaks and troughs for any one gasoline, while in all four the curves show peaks and troughs in approximately the same places.

A comparison of these curves with corresponding ones for pure paraffins, olefines, naphthenes and aromatics, seems to indicate a high concentration of naphthenes at the peaks, while the troughs show a corresponding high concentration of paraffins.

The similarity of curves in all four shows that the same components are present in each case, differing only in amount, while a comparison of the troughs with the curves of pure paraffins seems to support the view that most of the paraffins present are straight chained.

Much closer fractionation of one of the gasolines gave much higher peaks and correspondingly depressed troughs, as was to be expected.

While the results of this work are of considerable speculative interest the authors do not consider them as warranting conclusions.

Production of Liquid Fuel from Coal.   (Ind. and Eng. Chem., Vol. 19, No. 1.)   (8.511/5549 U.S.A.)

This Journal contains a symposium on the processing of coal. Articles are included which survey the sources of fuel supply and the various methods of effecting the low temperature cabonisation of coal. The composition of light oils from the low temperature carbonisation of Utah coal is given. The situa-

tion in Great Britain relating to low temperature carbonisation is described by D. Brownlie, and various processes are described.

Makhonine Non-inflammable fuel. (Aviation, 31.1.27.) (8.51/5280 France.)

This fuel is stated to be non-inflammable under normal atmospheric conditions, and it is stated that it can be substituted for petrol with only slight changes in carburettor adjustment. The main basis of the fuel is coal-tar. The French government has been testing this fuel for some time, and it is stated to own all rights to its use.

In Les Ailes, 20.1.27, it is stated that the Air Union has abandoned tests on this fuel, but the reason is not clear. The Air Union drew attention to the solidification of the fuel at low temperatures, but stated that the remedy was simple and that it was in no way a serious obstacle to the adoption of the fuel for aircraft engines. S.T.Ae. are stated to have come to an agreement with the inventor and further tests are to be carried out.

Laboratory Method of Determining Starting Properties of Motor Fuels. (W. G. Lovell, J. D. Coleman and T. A. Boyd, Ind. and Eng. Chem., Vol. 19, No. 3.) (8.82/5571 U.S.A.)

An attempt has been made to devise a laboratory method of determining the readiness with which an explosion may be obtained with any given fuel at the temperature desired. The method consists in measuring directly the air-fuel ratio necessary to produce an explosive mixture at any given temperature. It has been applied to the testing of a considerable number of fuels of widely different properties over a broad temperature range and has been found to yield results that are comparable with those obtained in starting tests on engines. The method is fully described and illustrated.

Gaseous Explosions (Effect of Fuel Constitution on Rate of Rise of Pressure). (G. C. Brown and G. B. Watkins, Ind. and Eng. Chem., Vol. 19, No. 2.) (8.57/5558 U.S.A.)

Apparatus suitable for the quantitative determination of the rate of rise of pressure of gaseous explosions is described. Normal hexane, heptane and octane; benzene, toluene, xylene; methyl, ethyl and amyl alcohols, and ethyl ether were used to prepare explosive mixtures with substantially theoretical oxygen and nitrogen. These mixtures were exploded under constant initial conditions and the pressure-time curves were graphically differentiated to obtain the maximum rate of rise of pressure. Comparison of the data so obtained indicates that the rate of rise of pressure in a progressive homogeneous reaction (one in which the flame moves progressively through the explosive mixture) increases with molecular weight in the paraffin series, varies inversely with the number of methyl groups added to the benzene ring in the aromatic series and is about the same for the higher alcohols as for the corresponding paraffin hydrocarbon.

Deterioration of Mineral Oils. (R. T. Haslam and K. Frolich, Ind. and Eng. Chem., Vol. 19, No. 2.) (8.41/5557 U.S.A.)

Certain conclusions as to the mechanism of the oxidation process have been drawn for a detailed study of the oxidation by a dynamic method of highly refined mineral oil.

(1) Start of oxidation is manifested by change in colour and by increasing acidity and viscosity.

(2) The rate of oxidation increases with temperature and is about five times as rapid with pure oxygen as it is with air.

(3) A number of organic compounds have been found to act as inhibitors of the oxidation. Others have been found to act as positive catalysts or not to affect the process at all.

As a result of these and other conclusions, a scheme for the mechanism of the oxidation of mineral oils is proposed.

2   Dopes and Detonation

Spectrography of flames in a combustion engine.   (A. Henne and G. L. Clark, Compt. Rend., 1927, 184, 26-28—abstr. in British Chem. Abstr. B, 4.3.27.) (8.514/5335 France.)

The explosion spectra of a combustion engine operating normally, with "knocking," and in the presence of anti-detonators, have been photographed at four stages of each explosion. The extent of the "knocking" is measurable by the movement of the lines of the normal spectrum towards the ultra-violet, and is greatest in the first quarter of the explosion. "Knocking" is due to a sudden liberation of energy the effect of the addition of an anti-detonator being to distribute this over a longer period of time. All the substances used (lead, tetraethyl, aniline and ethylenic hydrocarbons) produce the same spectrum as was obtained under normal circumstances. Lines due to lead appeared only in the first quarter of the explosion, indicating that the catalytic action takes place at the beginning of the reaction. The artificial "knocking" was produced by pressure.

Ionisation in Flames.   (E. Marx, Ann. d. Physik, 81, 5, pp. 454-492, 18.10.26— abstr. in Sc. Abstr. A, 25.2.27.)   (8.514/5330 Germany.)

This paper presents a comprehensive theory of ionisation phenomena in flame gases. From this theory of mobility, thermal ionisation and equilibrium conditions the reaction constants, recombination and dissociation coefficients, etc., can be calculated. The theory is supported by much experimental work.

"Pinking" in Internal Combustion Engines.   (G. S. Maxwell, Fuel, Vol. 6, No. 3.)   (8.514/5289 Great Britain.)

This article constitutes a very complete survey of the various theories put forward for the elucidation of the cause of knocking. It is stated that further experimental evidence is required on certain points. The spontaneous ignition theory, as modified by Callender's Nuclear hypothesis, seems to fit the facts better than any other suggestion. A more detailed examination of the oxygenated compounds, formed during a preliminary oxidation of paraffin hydro-carbons, is required, since the formation of organic peroxides has not yet been definitely proved.

The solution of titanous sulphate used to detect their presence is said by Engler to be a test for hydrogen peroxide, not for organic peroxides.

The latter, however, form hydrogen peroxide in the presence of moisture by autoxidation, so that they react to titanous sulphate if not carefully purified. It would appear that the action of "knock inducers" on peroxide formation must also be investigated.

Detonation.   (W. A. Whatmough, Automobile Eng., March, 1927.)   (8.514/5564 Great Britain.)

This paper discusses some practical considerations relating to detonation in internal combustion engines. The rate of detonation and molecular stability are dealt with. The fuel factors which individually or conjointly predispose or prevent detonation are stated to be :—

1. The compositions of the fuel.

2. The degree of sub-division of the liquid fuel.

3. The amount of admixture of air therewith.

4. The stability of the mixture at induction pipe temperature.

5. The extent to which evaporation of liquid fuel is completed within combustion chamber.

The compositions of motor fuels is also discussed.

Detonation in Internal Combustion Engines. (Letter from A. A. Egerton and S. F. Gates, Nature, Vol. 119, No. 2994, March, 1927.) (8.514/5567 Great Britain.)

It is stated that the following conclusions amongst others have been reached during an investigation on the effect of " anti-knocks " in petrol engines.

1. Anti-knocks do not influence detonation in rapid combustion mixtures.

2. They function in the initial stages of the combustion as negative catalysts.

3. Those metals which give the effective organometallic anti-knocks are found to be capable of forming higher oxides. The unstable peroxides formed in the combustion of the fuel and the metallic peroxides, are considered mutually to destroy each other. The rate of destruction of the combustion catalyst is greater than its rate of production, so that combustion is delayed. The metal atoms in a state of incipient oxidation are thus effective anti-catalysts.

4. The purely organic anti-knock, like aniline, is effective for the same reasons.

5. Both for ignition and knocking there is a condition of sensitiveness to change of reaction rate and the effect of anti-knocks is in general much the same on the two phenomena.

The views given are supported by the effect on such substances (aldehydes, organic peroxides, etc.) which permit knocking.

Dopes and Detonation. (1926 by H. L. Callender, Engineering, Feb. 4, 11 and 18, 1927.) (8.514/5553 Great Britain.)
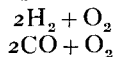
It is noted for reference that the results of the work carried out at the Air Ministry Laboratory on dopes and detonation in internal combustion engines have been published in the Journal mentioned above. This work is, of course, well known to the D.S.R. and D.T.D. staffs concerned.

The Rating of Fuels in the Order of Detonation. (W. F. Faragher and W. H. Hubner, J. Soc. Automotive Eng., Vol. 20, No. 3, March, 1927.) (8.514/5577 U.S.A.)

This paper comprises a description of the construction of an apparatus and the development of a method of operating it in determining the rating of motor fuels in order of their detonation. A Delco-light unit, consisting of a single cylinder internal-combustion engine directly connected to a direct-current generator, was the basic outfit used but it was changed in many ways in its course of development as a testing machine. The changes made are explained in detail. The method of testing adopted for rating a motor fuel was to match it, by trial and error, with a blend of chemically pure benzine and selected straight-run Pennsylvannia fuel. Several series of experiments were made to determine what blend or blends of benzene and the standard fuel match a given fuel under widely different conditions of compression-ratio and spark-setting. The author hopes to standardise these blends later in terms of pure heptane and pure octane, as has been proposed by Dr. Graham Edgar. The results obtained in the experiments are presented graphically.

Studies of Combustion: The burning of hydrogen and carbon monoxide. (W. G.
Lovell, J. D. Coleman and T. A. Boyd, Ind. and Eng. Chem., Vol. 19,
No. 3.) (8.57/5573 U.S.A.)

The results of experiments described in this paper indicate that the simul-
taneous burning of carbon monoxide and hydrogen in a gasoline engine probably
takes place according to the reactions :—

$$2H_2 + O_2$$
$$2CO + O_2$$

where the ratio of the velocity constants

$$k_{H_2} : k_{CO} = 2.3.$$

Neither these reactions nor their relative rates are changed by a small increase
in the compression ratio, or by the presence of a knock inducer or a knock
suppressor, as long as detonation does not occur. The simultaneous combustion
of two individual fuels in an engine at rates widely different for each does not
appear to be in agreement with the concept of a narrow zone or flame
advancing across the cylinder, within which combustion is completed.

Studies of Combustion: Determination of rate of burning by Chemical Analysis.
(W. G. Lovell, J. D. Coleman and T. A. Boyd, Ind. and Eng. Chem.,
Vol. 19, No. 3.) (8.57/5572 U.S.A.)

As a departure from the usual methods of investigating combustion in internal
combustion engines, a study has been made of the burning during its progress,
from a chemical point of view. The ordinary method of examining combustion
by means of the engine exhaust is subject to the disadvantages that combustion
occurs so long before the exhaust stroke that the final products do not give
definite information as to how it has proceeded. It is important, therefore, to
sample gases from the cylinder during the actual explosion period. For this
purpose, a special quick-acting, water-cooled, sampling valve has been devised,
which makes it possible to follow the progress of combustion.

This new experimental method yields data particularly adapted for determining
the rate of combustion. The knock is accompanied by an increase in the rate
of burning of fuel, whether the detonation is caused by addition of kerosene,
or by the presence of a chemical knock inducer. In the presence of tetraethly
lead fuel burns at about its normal rate.

*Gaseous Explosions: Probable mechanism causing detonation in the internal
combustion engine.* (G. C. Brown and G. B. Watkins, Ind. and Eng.
Chem., Vol. 19, No. 3.) (8.514/5574 U.S.A.)

It was found that if the maximum rate of rise of pressure as determined
in a progressive homogeneous reaction under constant initial conditions be
divided by the autoignition temperature on the absolute temperature scale, a
number is obtained which varies directly as the knocking tendency of that particular
fuel in an engine, or inversely as Ricardo's " highest useful compression ratio "
for that fuel.

This fact suggests rate of rise of pressure and autoignition temperature as
the two factors determining the tendency of fuels to knock in an engine and
autoignition of the unburned mixture adiabatically compressed against hot
surfaces as the mechanism causing " fuel knock " in an internal combustion
engine.

*Gaseous Explosions: Rate of rise of pressure, velocity of flame travel and the
detonation wave.* (G. G. Brown and G. B. Watkins, Ind. and Eng.
Chem., Vol. 19, No. 3.) (8.514/5575 U.S.A.)

Velocity of flame travel and rate of rise of pressure are shown to be similar
and vary in the same way with changing initial conditions.

Detonating mixtures of pure liquid fuels and substantially theoretical oxygen were exploded with varying amounts of nitrogen in the constant volume bomb. The amount of nitrogen necessary to reduce the intensity of the detonation to an arbitrary standard was found to vary directly as the rate of rise of pressure as reported in the previous paper. These data lead to the conclusion that the rate of rise of pressure upon explosion of a fuel mixture is the major factor indicating the tendency of that fuel mixture to set up the detonation wave in a progressive homogeneous reaction, and that engine knock is not due to a detonation wave as recognised in progressive homogeneous explosions.

3 Heavy Oil Engines

The Sperry Aero Oil Engine. (Aviation, Vol. 22, No. 10, 7.3.27.) (12.81/5563 U.S.A.)

This article gives an account of a paper read by Mr. Sperry before the Metropolitan Section of the Society of Automotive Engineers. It is stated that the most highly developed light weight Diesel Engines are still too heavy for air use. Attack on the problem in the Sperry Laboratory has been largely confined to the evolution of a design which would permit the use of a higher mean effective pressure than is ordinarily used. It is proposed to obtain this by the use of a high initial supercharging pressure combined with 2-stage expansion which continues the power impulse of the expanding gases through a larger arc of the crankshaft revolution than is possible in oil engines which exhaust to the outer air. A power unit, built along aeronautical lines and capable of developing 250 h.p., is in the design stage.

4 Carburettors

Non-back-firing Carburettor for Aircraft Engines. (Le Genie Civil, Vol. 98, No. 26—abstracted and illustrated in Mech. Eng., Vol. 49, No. 3.) (8.53/5578 France.)

A carburettor designed by R. LeGrain is described, in which the non-back-firing feature has been worked out on the basis of the fact than an air fuel mixture containing an excessive amount of the latter does not support the propagation of a flame. It is claimed that on the engines on which this carburettor was tested a slight increase of power output was noticed, accompanied by a notable diminution of fuel consumption. The original article shows how this carburettor is installed on a 480 h.p. Renault engine.

5 Test Engines

Description of the N.A.C.A. Universal Test Engine and some Test Results. (M. Ware, N.A.C.A. Report No. 250.) (8.18/5286 U.S.A.)

This report describes the 5in. bore by 7in. stroke single-cylinder test engine used at the Langley Field laboratory of the National Advisory Committee for Aeronautics in laboratory research on internal combustion engine problems and presents some results of tests made therewith.

The engine is arranged for variation over wide ranges of the compression ratio and lift and timing of both inlet and exhaust valves while the engine is in operation. Provision is also made for the connection of a number of auxiliaries. These features tend to make the engine universal in character, and especially suited for the study of certain problems involving change in compression ratio, valve timing and lift.

Incidental to investigations of carburettor and fuel injection engine problems, considerable data have been obtained which indicate the effect of changes of compression ratio on friction horsepower and volumetric efficiency. From this and some other work, it appears that with a change in compression ratio from

5 to 13, the friction horse-power obtained by motoring the engine increases by about 15 per cent. The volumetric efficiency of the engine was found to remain practically unchanged between compression ratios of 5.3 and 7.3 with carburettor operation and between 9.5 and 13 with fuel injection operation.

The results of some tests are presented showing the power obtained when operating as a carburettor engine on aviation petrol at compression ratios in excess of that which will permit full throttle as a normal engine and controlling detonation by throttling the intake charge and by varying the inlet valve timing. For fixed compression ratios in these tests throttling gave the least power while variation of the inlet valve closing time, with the opening time kept fixed, gave the greatest power for the conditions tried.

6   Ignition Systems

(F. G. Shoemaker, J. Soc. Automotive Eng., Vol. 20, No. 3. March 1927)
    (8.9/5576 U.S.A.)

An account of a lecture by Mr. Shoemaker is given. He stated that the ideal ignition systems should have the following characteristics :— (a) a rugged, light and compact source of sparks; (b) flange mounting; (c) bearings large enough to allow the use of a direct splined shaft or gear drive; (d) complete enclosure of the ignition system in a metallic housing conforming to the space available on the engine; (e) secondary cables carried in substantial metallic housings, built into the cylinder-block and connected directly to the distributor housing, without flexible braid or tubing, thus providing radio shielding, mechanical protection and eliminating the fire hazard; (f) ignition drive from the propeller end of the crankshaft, to eliminate drive stresses; (g) ignition for starting direct from " running " magneto without the use of a booster magneto; (h) electrical insulation for supercharging to at least 20,000ft.; (i) a normal life without lubrication, adjustment, or cleaning greater than the time between major overhauls of the engine; (j) accessibility in the airplane for inspection of breaker and distributor; (k) easily removable and interchangeable breakers, condensers, coils and distributor parts; and (l) standardisation of the basic parts of a given make, such as main frames, coils, condensers, rotors, bearings, breakers and the like, to make it possible to use the same parts for all types of engines.

It was stated that the following may be considered as having reached the development stage :— (a) a reduction in the weight of the ignition system of from 25 to 40 per cent.; (b) an increase in the satisfactory operating speed of magnetos of at least 100 per cent.; (c) extension of the life of the magneto breaker at least five times; (d) elimination of the fire hazard; (e) direct drive without flexible coupling; (f) flange mounting; and (g) the air-gap distributor.

7   Rotary Pumps and Gear Pumps

Experiments with Rotary Pumps and Gear Pumps. (F. Aschner and L.
    Mattheus, Der Motorwagen, Vol. 30, No. 7, 10.3.27.) (8.42/5541
    Germany.)

The object of the tests reported on in the present article was to determine the volumetric efficiency, or ratio of actual delivery to theoretical delivery per unit of time, of oil pumps with various values of pressure, pump speed and oil temperature, in order to ascertain the most favourable conditions for the functioning of the pump. A rotary lubrication pump from a Hispano-Suiza aero-engine, a gear pump for motor-car engines by Breuer and Co. and a gear pump by Ludwig Loewe & Co. were tested by means of a special plant (described in the article). The results of the tests are given by means of a series of curves of the volumetric efficiency both as a function of the viscosity and of the pump speed, with various values of pressure, and also of the delivery as a

function of pressure with various speeds. The following table gives the results for the most usual conditions of working, the viscosity of the oil being in all cases 6.8 Engler degrees at 50 deg. C.

Breuer Pump.			(Speed 1,500 r.p.m.)				
Pressure in atm.	o	0.5	1.0				
Vol. efficiency	80%	48%	26%				
Actual efficiency	—	2.2%	2.5%				

Loewe Pump.			(Speed 500 r.p.m.)			
Pressure in atm.	o	1	2	4		
Vol. efficiency	88%	87.4%	80%	60.6%		
Actual efficiency	—	29.4%	36%	37.6%		

Hispano Suiza Pump.			(Speed 1,000 r.p.m.)			
Pressure in atm.	o	1	2	4	7
Vol. efficiency	90%	79.2%	74.1%	65.6%	56.4%
Actual efficiency	—	18.95%	29.5%	36.0%	29.0%

AERODYNAMICS AND HYDRODYNAMICS

8 Fluid Motion

Calculation of turbulent spreading flow. (W. Tolmien (Göttingen), Z.f.A.M.u.M., Vol. 6, Dec., 1926.) (5.32/5540 Germany.)

The article deals with the mathematical investigation of the distribution of velocity in various cases of " free turbulence," *i.e.*, flows not bounded by walls, on the basis of the theory recently propounded by Prandtl (see Z. ang. Math. u. Mech. Vol. 5 (1925), p. 136) for the turbulent interchange of momentum in stationary flows. The author considers first the mixing processes occurring between a stream moving at uniform velocity and the surrounding air at rest, and then analyses how the stream spreads out into the surrounding air. Experiments show that the width of the zone in which mixing occurs increases in linear ratio with x, x being the distance from the point where the mixing commences. A method of taking into account the pressure differences and thus improving the calculations, in which constant pressure is postulated, is given and also a more complete expression for the apparent tension set up by the turbulent interchange of momentum.

Configuration of flow round a circular cylinder. (Masami Ono, Aeronautical Research Inst., Univ. of Ostend, Z.f.A.M.u.M., Feb., 1927, pp. 9-12.) (5.32/5310 Belgium.)

The author assumes that there is a Prandtl boundary layer outside which potential flow exists. Within the boundary layer the velocity is expressed tentatively as a cubic with undetermined coefficients. Proceeding along the same general lines as Prandtl and v. Karman and making various approximations a solution is obtained involving a power of the velocity of the value 1.836. The angle between the dam point and the point at which the boundary layer breaks away from the surface is found to be 106° agreeing roughly with observations and Reynolds' criterion is found to be $U_r/v = 2.84 \times 10^3$ which is comparable with the value for pipes.

The treatment must be regarded as empirical, and any value lies in the accuracy with which it agrees with observed facts.

Drag of an aerofoil for two-dimensional flow. (A. Fage and L. J. Jones, Proc. Roy. Soc., A. 759, 1926, pp. 592-603.) (5.32/5314 Great Britain.)

The authors continue the exploration of the velocity field referred to in Bryant and Williams' paper (on p. 12), using the expression for drag in terms of tail momentum given by G. J. Taylor (*cp.* Filon).

The distribution of normal pressure is measured and integrated over the surface and accounts for 80 per cent. of the total, the remaining 20 per cent. being assigned, by subtraction, to the vector integral of the tangential forces, which may be defined as " skin friction."

The loss of total head is integrated along the whole span for incidence of minimum drag, close to the aerofoil, and agrees with the measured drag. The integral of normal forces at the medium section and the total head losses behind the medium section are plotted between incidences $-10°$ and $+14°$, and show the same general run.

Air flow pattern in the wake of an aerofoil of finite span. (A. Fage and L. F. G. Simmons, Trans. Roy. Soc. A., 1926, pp. 303-330.) (5.32/5313 Great Britain.)

The authors explore the velocity field by direct measurement for the first time with sufficient accuracy and detail to analyse the flow in accordance with Lanchester's hypotheses and establish directly and quantitatively the physical existence of vortices trailing from the wing tips.

The relations between lift and circulation are confirmed. Numerous interesting details are confirmed—the folding of the vortex sheet, the diffusion of vorticity as the trailing cores pass down stream, the concentration near the wing tips, etc.

Aerodynamics of the Biplane. (N. K. Bose (Calcutta) with notes by L. Prandtl, Z.f.M.u.M., Feb., 1927, pp. 1-9.) (5.331/5312 Germany.)

The induced velocities are found by evaluating integrals of the usual type and checked with planimetry. The influence of the curvature of the stream lines is investigated, on the lines of Kutta's investigation, and approximate expressions found for coefficients of lift and moment.

The curvature of the streamline is expressed in elliptic integrals and tabulated and given graphically.

The circulation and profile drag are determined experimentally and the coefficients of lift, drag and moment are then deduced. Comparison with direct measurement is tabulated and shows fair agreement.

The resistance of spheres. (H. Liebster, Ann. d. Physik, No. 4, 1927, pp. 541-562.) (5.32/5535 Germany.)

Cinematograph records were made from the region of resistance as the velocity to that of resistance as velocity square. The resistance was found to be a continuous function of Reynolds' number. At low speed the results agreed with the theories of Stokes and Oseen. Near a sloping wall the observations agreed with Faxen's equation better than with Lorentz and Stokes', up to 0.15cm. diameter. When Reynolds' number exceeded 0.5 irregular oscillations appeared indicating irregular instability in the tail, unlike the stable (*sic*) formation behind a cylinder.

Supposed variation of coefficient of viscosity with rate of shear. (J. W. Lewis, M.Sc., Phil. Mag., Feb., 1927, pp. 429-432.) (5.32/5532 England.)

It is shown that the experiments by K. Molin (1920) from which a variation was inferred required correction for the friction torque of the apparatus, which is sufficient to account for the departure from Stokes' linear relation.

Notes on the connection between lift and circulation. (Prof. G. I. Taylor, Trans. Roy. Soc. A., 1926, pp. 238-246.) (5.32/5315 Great Britain.)

With reference to Bryant and Williams' paper, noticed below, the author shows that it is necessary to define the contour taken for determination of the circulation, as cutting the " tail " at right angles, otherwise the circulation may

vary with the contour selected. (In an extreme case Bryant and Williams obtain a decrease of 10 per cent.) An elegant illustration is given from the Kirchoff Rayleigh problem of resistance in a perfect fluid with a wake at rest separated from the stream by steady surfaces of perfect slip. Expressions are given connecting lift and drag with the velocity field in a perfect fluid.

Flow of air around an aerofoil of infinite span. (L. W. Bryant and D. N. Williams, Trans. Roy. Soc., 1926, A. 225, A. 225, pp. 199-237.) (5.32/5316 Great Britain.)

The authors explore the velocity field round the wing and establish experimentally the existence of circulation of substantially irrotational motion outside the boundary layer and tail, and of distribution of lift, with remarkably accurate confirmation of the Lanchester-Prandtl relations. The experimental exploration of the tail affords data for further progress in setting up a physical theory of profile drag.

Certain Irrotational Motions of Viscous Liquids. (A. Rosenblatt, Comptes Rendus, 192, pp. 556-8, 4.10.26—abstr. in Sc. Abstr. A, 25.2.27.) (5.32/5337 France.)

Proves two theorems, (1) that in the irrotational motion of a viscous fluid, if the force is normal to the equipotential surfaces, then these are parallel surfaces; (2) if in addition the fluid is incompressible, then the only possible families of surfaces are parallel planes, coaxial cylinders, and concentric spheres.

Removal of Surface Layer by Suction in Fluid Flow. (J. Ackert, Z.V.D.I., Vol. 70, pp. 1153-1158, 28.8.26. Abstracted in Sc. Abstr., Vol. 30, No. 349.) (5.32/5182 Germany.)

When a fluid flows past and round an obstacle the surface layer of " dead fluid " at the rear of the obstacle may be removed by suction through apertures provided in the body itself, and the turbulence may be much reduced by this means. The results of some experiments on different forms of obstacles are described in the paper, and in an appendix a theory of the phenomenon is given in mathematical form.

9 Pressure Distribution over Aerofoils at High Speeds

(N. J. Briggs and H. L. Dryden, N.A.C.A. Report No. 255.) (5.421/5554 U.S.A.)

This report deals with the pressure distribution of aerofoils at high speeds. The tests were made on models of 1in. chord and comparison with the early measurements on models of 3in. chord shows that the sudden change in the lift coefficient is due to compressibility and not to a change in the Reynolds number. The Reynolds number has a large effect however on the drag coefficient.

The data observed are useful to the airscrew designer in connection with the load distribution and high speeds.

10 Rotors

Industrial Applications of the Flettner Rotor. (F. O. Willhoft, Mech. Eng., Vol. 49, No. 3.) (17.4/5579 U.S.A.)

The characteristics of the rotor are given and its suitability for application to wind-wheels is discussed. It is proposed to construct a 100ft. wheel with Savonius rotors to generate 183 h.p.

11   Hot Wire Instrument for Measuring Airflow

Hot Wire Instrument for measuring speed and direction of airflow. (L. F. G.
Simmons and A. Bailey, Phil. Mag., 1927, pp. 81-96 and plate II.)
(11.15/5317 Great Britain.)

The authors describe the construction and calibration of one, two, three and
four wire instruments of this type as used in exploring the flow of air behind
an aerofoil.

The necessity of calibrating periodically for " ageing " does not prevent the
instrument from being more convenient for numerous and rapid readings, both
of velocity and direction, than the pitot tube.

The reduced observations agree well with the pitot tube results except in
the region of most intense vorticity where there may be doubt as to the relation
between a variable air flow and the cooling of the hot wire or the mean pressure
in the pitot tube. Elsewhere the mean readings seem to be a satisfactory measure
of the time mean velocity field in so far as concerns the aerodynamical forces
set up as an aerofoil—a result of fundamental importance.

AIRCRAFT   DESIGN

12   Stresses and Accelerations in Flight

Acceleration of Aeroplanes. (J. V. Koppen and W. Huebner, Z.F.M., Vol. 17,
No. 24, 18.12.26, pp. 534-7—abstr. in Nachrichten f. Luftfahrer, Vol. 8,
No. 3, 20.1.27.) (5.261/5565 Germany.)

The measurements carried out by the D.V.L. of the acceleration undergone
by various aeroplanes in different evolutions with the D.V.L. recording accelero-
meter type YV (cf. Z.F.M., Vol. 17, No. 24, December 28th, 1926) yielded much
lower values, particularly in the pull out from a nose dive, than the American
experiments carried out by Doolittle, in which the theoretical maxima were almost
reached. Assuming the same basis for the measurements, the difference may
be explained by the lower power of the elevator control, or the greater moments
of inertia about the lateral axis of the German aeroplanes.

VALUES OF MEASURED ACCELERATIONS.

Evolutions.	Albatros L.68	Albatros L.68a	Junkers A.20	Junkers A.35
Turn at full throttle.	2.3g, 2.7g	2.7g	2.8g	2.5g
Gliding turn.	3.8g	2.9g	3.1g	3.0g
Looping.	(2.8g, 2.8g) (3.2g, 3.8g)	(2.6g, 2.9g) (3.0g)	3.0g, 3.4g	2.9g, 3.0g
Rolling.	4.0g	2.7g	4.1g	3.5g
Spin with engine off.	3.0g	2.4g	3.6g	3.6g
Spin with engine on.	3.5g	2.7g	3.2g	3.5g
Gradual pull out after a nose-dive.	at 180 km/hr 2.1g	at 200 km/hr 2.4g at 250 km/hr 3.4g	at 240 km/hr 3.4g	2.3g
Sudden ditto.	3.1g (7.7)	3.6g (7.1) 4.0g (10.3)	at 250 km/hr 3.9g (9.7)	3.1g (9.7)

The figures in parentheses ( ) are the theoretical maximum values of accelera-
tion in pulls out from nose dives.

New investigations on aeroplane stresses in flight. (M.M. Huguenard, Magnan
and Planiol, Bull. Tech. du S.T. Ae., No. 3, Dec., 1926.) (5.26/5534
France.)

Chap. I., pp. 5-22. Theory, design and use of accelerometers. The relation
of damping to the ratio stress displacement of the spring is fundamental. By

proper adjustment the error lies well within $\pm$ 4 per cent. of a mean curve. The sensibility of the instrument multiplied by the square of the natural frequency is taken as a figure of merit, and in four S.T.Ae. instruments this product ranged from 9,000 to 800,000 compared with figures 1,600 and 2,130 for two instruments produced by outside firms.

Chap. II., pp. 23-27. A description of a recording speed meter with a natural period of 1/40 second. The records lie within 1.1 km. per hour ($\pm$ 4 per cent. of max. speed) of a mean curve. The manometer had an error of 3 per cent., combined probable error 5.5 per cent.

Chap. III., pp. 28-30. An arrangement for test recording of strains in the frame during flight (Bulletin No. 24). Special readings by fluid transmission to a recorder.

Chap. IV., pp. 31-33. Apparatus for determining flight trajectories. A cinematograph camera is mounted like a machine gun and follows the motion of an aeroplane through a ruled screen.

Chap. V., pp. 34-52. Simultaneous observations of speed acceleration and elevator movement during flying manœuvres. Three recording pins mark on the same drum the flight speed, vertical acceleration and elevator movement. Examples are given of triple records and of reduction to tabulated numerical data.

Chap. VI., pp. 53-63. Speed, acceleration and spar strain are measured simultaneously. Approximately linear relations between acceleration and spar strains are given graphically.

Chap. VII. An application of the method of Chap. IV. to two aeroplanes, one for speed (200 km. per hr.) the other looping the loop. A large number of reproductions of film exposures are given, showing the variable positions of the aeroplane on the ruled screen alternating with chronographic records of the time.

13   Structures

Determination of the best sectional dimensions of a hollow rectangular built up spar. (A. v. Baranoff, Z.f.M.u.M., Feb., 1927, pp. 81-83.) (5.21/5543 Germany.)

Adopting the views and methods of Newlin and Trayer, N.A.C.A. Technical Reports No. 180, 181, 178, graphical determinations in families of curves determine the proportion of flange widths and depths, for the development of maximum resistance against both end loading and bending, taking into account the test qualities of the timber used. With increasing tensile strength of the timber, the ratio of cross section area of pressure flange to tension flange increases, while the flanges become thinner in proportion to girder depth. On the contrary with increasing compressional strength the ratio of flange to girder depth increases and the ratio of area of compression to tension flange decreases.

14   Airscrews

Preparing laminations for airscrews construction. (Otto Steinitz, Z.f.M.u.M., pp. 93-95, Feb., 1927.) (5.462/5533 Germany.)

A number of workshop methods and tests are given.

Airscrews for high flying aeroplane. (Paper at a discussion of the Wiss. Gesell. fur Luftfahrt, Z.f.M.u.M., Feb., 1927, pp. 83-93.) (5.41/5544 Germany.)

The author dismisses as impracticable for heavily loaded commercial vehicles a current proposal to set up flying routes in the regions above the troposphere (10 km. and upwards) with a view to developing higher speeds in the rarer air (less than one quarter the density at ground level), but considers the particular problem of designing airscrews for high flying aeroplanes. He gives nomographs for a range of 10 atmospheres to 1/100 atmosphere and concludes that no special difficulties of design and construction arise.

Balsa Wood Airscrew. (Aviation, 7.2.27, p. 271.) (10.31/5283 U.S.A.)

An airscrew is illustrated having a diameter of 17ft. 6in. The material Balsa Wood, is stated to weigh only $\frac{1}{8}$ as much as birch or oak. Method of constructing airscrew is described.

15 Brakes for Aircraft

(U.S. Air Services, Feb., 1927.) (5.55/5552 U.S.A.)

Early in 1925 McCook Field undertook the study and development of brakes for the Douglas D.T.1 for the purpose of increasing ground control. Disc type brakes were used; a duralumin disc sufficiently conical to lie parallel with the spokes was rivetted to the rim of the wheel. The disc was extended to the centre where it rested on the hub of the wheel. Outside this was the lined breaking disc.

These brakes functioned satisfactorily and are still in regular service. The run of the aircraft after landing was reduced from about 1000ft. to about 350ft. by the use of these brakes and with no noticeable tendency to nose over.

The next brakes developed were the separately controlled hydraulic brakes for the P.1 aircraft. It is understood that these brakes are also in satisfactory operation.

16 Wing Design

Precision of wing sections and consequent aerodynamic effects. (F. Rizzo, N.A.C.A. Tech. Note No. 255.) (5.31/5178 U.S.A.)

This investigation was carried out by the N.A.C.A. to determine the precision of wing sections of wood-fabric construction used on a number of airplanes. It was found that all wind sections deviated more or less from their respective prototypes. The mean thickness of the section was computed for those wings with a noticeable sag. The aerodynamic effects resulting from consideration of thickness variation are then estimated from existing empirical information. The rib, sag and specified measurements of fourteen sections investigated are given.

Flap gear for Aeroplanes. (A. Hessell Tiltman, Autom. Eng., Feb., 1927.) (5.313/5278 Great Britain.)

This article, which is well illustrated, contains a summary of the work done on variable camber wings, but particular attention is paid to one particular design of automatic flap gear.

17 Take-off and Landing Characteristics

Comparison of the take-off and landing characteristics of a number of service airplanes. (T. Carroll, N.A.C.A. Report No. 249.) (7.17/5165 U.S.A.)

This investigation is a continuation of N.A.C.A. Report No. 154, in which the take-off and landing characteristics of the J.N./4h were reported upon. The present report gives similar results for a number of U.S.A. service aircraft. The results include the air speed, ground speed, ground run distance, acceleration, and position of all controls throughout the take-off and landing operations for each aircraft.

18 Fire Prevention

Fire Prevention and Extinguishing Apparatus for use with Petrol Tanks. (L. Ingram, E.P. 262697, 16.12.26.) (16.12/5551 Great Britain.)

The invention comprises a glass receptacle containing a chemical fire extinguisher which is placed across the top of the petrol tank, and which can be broken by the impact of a plunger.

The protection of aircraft against fire risks. (J. A. Lefrance, La Nature, 1.3.27.) (16.12/5529 France.)

A general article on fire risks and their prevention. The author enumerates the best means of fire prevention; the use of powerful extinguishers, the mounting of the tanks as far as possible from the engine, the use of metal, more especially steel, in aircraft construction and considers that the best means of reducing fires in aircraft is the use of non-inflammable fuels such as Ketol or Makhonine.

INSTRUMENTS

19 Wireless

Secret Communication Systems. (J. Jammet, Onde Elec., 5, pp. 365-77. Abstracted in Sc. Abstr., Vol. 30, No. 349.) (13.1/5183 France.)

In this paper the author presents a system for ensuring secrecy of Morse messages transmitted by line or radio. The outstanding feature is the extreme simplicity of the system both in principle and mechanism. The underlying principle is the use of a key that is not in any way periodic and hence practically impossible to solve. The system involves the use of three relays which will be termed A, B and C. The C relay has its tongue and marking contact connected either to line or to the radio transmitter key through a battery in the normal way. One end of the operating coil of this relay is connected directly to the tongue of relay B, the other to the tongue of relay A through a battery. The spacing and marking contacts of relays A and B are connected together. The tongue of relay A is operated by the message to be transmitted. The tongue of relay B is operated by any arbitrary message. It will be seen that a dot in the real message may appear on the line as a dot, a portion of a long dash or a space, depending on the form of the message operating relay B. Thus quite unintelligible signals are sent to line. At the receiving end there is an exactly similar arrangement of relays, A′, say, being operated by the line currents, B′ by the same arbitrary message as B (it must, of course, be in exact synchronism with B), while the relay C′ operates an inker or other recorder and records the original message as fed into relay A. The author gives details of the methods adopted to secure the necessary synchronism and discusses the operation of the system in general.

Recent Developments in Short-Wave Wireless Telegraphy. (H. Rukop, Z.f. Hochfrequenztech., 28, 2, pp. 41-50, 1926. Abstracted in Sc. Abstr., Vol. 30, No. 349.) (13.7/5184 Germany.)

A full account is given of the results of an extensive series of researches relative to wireless transmission between Nauen on the one hand and Buenos Aires, Bandoeng and Osaka on the other, with waves of length between 70 and 13 metres. The results obtained show that the optimum wave-length lies between 16 and 28 metres. Generally speaking, the night hours have given good intercommunication, though there were also cases of good communication throughout the twenty-four hours by using two wave-lengths. The apparatus used for transmission of the short waves employed is described with illustrations, and the theory of propagation of short waves is put forward and discussed.

Propagation of Short Waves. (R. Mesny, Onde Elec. 5, pp. 434-459, Disc. 459-463, Sept., 1926—abstr. in Sc. Abstr. A., 25.2.27.) (13.7/5328 France.)

After outlining the phenomena which characterise the propagation of short waves, such as great range, zones of silence, influence of night and of the seasons, the author discusses the theories which have been put forward to explain the effects observed. The hypotheses on which physicists rely for justifying the existence of a conducting layer in the upper atmosphere are discussed, and this

is followed by a general treatment of the propagation of waves in an ionised medium, showing how reflection and refraction towards the earth arise. From the general theory an approximate explanation of the observed phenomena is deduced. In conclusion, experiments to test the validity of the theories put forward are dealt with, and the differences which still exist between observed effects and the consequences of the theories advanced to explain them are pointed out.

Piezo-Electric crystals for high frequencies. (A. Meissner, Jahrbuch der drahtlosen Telegraphie u. Telefonie—Z.f. Hochfrequenztechnik, Vol. 9, No. 1, Jan., 1927.) (13.21/5530 Germany.)

This article includes the description of a method for taking the resonance curve of quartz and of a new process for wave rectification. The crystal is connected in series with a helium valve and on resonance being established passes the current to the latter. The quartz crystal is further examined from the point of view of its capacity to produce oscillations, in particular for short-wave transmitters. Investigation of the symmetrical forces producing moments of rotation in a crystal with maximum length along the optical axis led to the construction of a small motor in which rotation is imparted to a crystal by the application of a high frequency current. As a result of the investigations the author was able to establish the relations between the optical and mechanical directions of rotation of a flat crystal, finding that these coincide.

Measurements in the field of a staff-shaped aerial excited with fundamental wavelength and with harmonics. (Ludwig Bergman, Ann. d. Physik, No. 4, 1927, pp. 504-540.) (13.1/5536 Germany.)

A valve transmitter excited undamped oscillations of 1.72 m. wave-length and set up even and odd harmonics in a staff-shaped aerial, which were measured up to the sixth harmonic.

Each frequency had its own direction of transmission in good agreement with Abraham's equations, for direction but not for strength. The possibility of determining the oblique direction emitted is stated to be of practical importance in propagating waves of short length.

A relation between the meteorological state and the propagation of electro-magnetic waves. (Records of the Prussian Aeronautical Observatory, Lindenberg, Vol. 15, 1926, pp. 292-296.) (13.1/5539 Germany.)

The Power of Propagation of Short Waves. (Pederson, Berlingske Tidende, 5.3.27.) (13.7/5555 Denmark.)

This article gives an account of a lecture on recent experiments on the power of propagation of wireless waves, and particularly short waves. It is a curious phenomenon that waves of a given length travel perfectly during the day and not at all at night, whilst the opposite is true for waves of another length.

The article discusses the connection between transmission of wireless waves and the conditions of the upper air.

20   Photography

K.8 Automatic Recording Aerial Camera. (Aviation, 28.2.27.) (14/21/5333 U.S.A.)

This camera is officially known as the Fairchild Military Fully Automatic Recording Aerial Camera, Type K.8. It is of the single lens type, fully automatic in its functioning and can be equipped to accommodate lens of focal lengths ranging from 21 c.m. to 50 c.m. On the outside edge of the 7in. × 9in. negative

is automatically recorded the hour, minute and second the photograph was taken, the inclination of the camera, the altitude, the number of exposures, focal length of the lens, and the day, month and year.

Photography through mist. (Chem. Zentr., 1927, 98 (1) 1110.) (14.5/5331 Germany.)

Photographs taken by W. H. Wright (Lick. Sternwart) on plates sensitised to ultra-red light (max. 770 to 820 $m\mu$) with Kryptocyanin and Neocyanin respectively are given. The penetrative power of ultra-red light through mist permits the taking of objects at 200 km. range which remain hidden to un-sensitised plates as well as to the naked and and aided eye. Photographs cf Mars are made possible through several km. of thick Martian atmosphere. The importance of ultra-red sensitisation to the film industry is mentioned; by its aid it is possible during daytime and with the normal exposures to take " night photographs " since the sky is rendered black, the surroundings appearing bright by contrast.

Air Survey. (Am. Soc. C.E., 52, 367-395—abstracted in Eng. Abstr., Jan., 1927.) (14.1/5167 U.S.A.)

The author states that in order to convert the data of photographs to a uniform scale a number of obstacles and limitations must be overcome. Some of these are inherent in all photographs, some are characteristic of photographic materials and some are due to difficulties in practical operation. The most troublesome, however, are those involving mechanical obstacles. He considers these limitations at length and discusses the mosaic with its advantage of speed and disadvantage of lack of uniform scale. He deals with field operations, flying, photographing, ground control and office work, and describes the measuring stereoscope and the method by which each plate is " horizontalised " after the tilt has been determined. In a test case, compared with an instru-mental ground survey, the photographic map coincided very satisfactorily with the instrumental survey. Aeroplane contours were determined within an error of $-2\frac{1}{2}$ ft.

The Hugershoff " Aerocartograph." (E. R. Krahmer, Luftfahrt, Vol. 31, No. 5, 5.3.27.) (14.31/5569 Germany.)

This article on air surveying in general and on the aerocartograph in particular gives the following information on this new instrument which has been evolved by Dr. Hugershoff to meet the demand for a portable instrument. It weighs 200 kg. (441 lbs.) and its dimensions being $80 \times 111 \times 170$ cm. (2 ft. 7 in. $\times$ 3 ft. 8 in. $\times$ 5 ft. 7 in.), it can be transported by motor lorry without difficulty. The " aerocartograph " is built on the same principles as Dr. Hugershoff's well-known " autocartograph " and can be used to plot maps from oblique or vertical photographs taken from an aircraft, or from photographs taken on the ground. It is constructed for focal distances of 12 to 30 cm. and square or rectangular plates with wides measuring from 6 to 18 cm. It can be worked by one operator. The aerocartograph is provided with a special system which does away with the necessity for triangulation in areas with landmarks 50 km. and more apart and thus is particularly suitable for surveys in undeveloped countries.

21 Lighting Equipment

Navigation Lighting Equipment. (Flight, 10.2.27.) (6.64/5279 Great Britain.)

The article describes and illustrates a new series of navigation lamps con-structed by Vickers, Ltd. A saving of weight of 57.5 per cent. is stated to have been obtained and a reduction in frontal area of 9 per cent. accompanies the

saving in weight. The generating equipment has also been redesigned with a saving of weight of 4½ lbs. The weights are airscrew, 6 ozs.; generator and mounting, 11 lbs. 6½ ozs.; combined voltage control regulator and output, 3 lbs. ½ oz.; voltmeter, 9 ozs.; special 340 amp. accumulator, 40 lbs. empty.

Aircraft lights and ground lights. (M. Marsat, Revue Generale de l'Electricite,
    No. 23, Vol. 10, 4.12.26.) (6.64/5176 France.)
    This is a summarised report of a paper published in the " Bulletin de la Ste. Francaise des Electriciens " for August, 1926. It is mostly a comparison between lights of the lens and reflector type, the author being an emphatic partisan of the latter. The question of range is dealt with, the author pointing out that as the range of a light varies with the duration of a flash, the light periods of a flashing light should be all of the same duration, the required characteristic being given by varying the durations of the eclipse. He also mentions the recent discovery that the intensity of a beam of light does not decrease uniformly with distance over all the extent of the beam, the decrease in intensity being much greater at the periphery than at the centre.
    It is stated that a large number of air lights of medium range is preferable to a smaller number of powerful lights placed further apart, as was proved in the tests on the Paris-London airway; and also that for A.A. work wide angle lights often give good results where more powerful lights throwing a narrow beam are inefficient.

Aerodrome Lighting. (O. Werner, Aviation, 28.2.27.) (20.5/5332 U.S.A.)
    The article includes an account of the revolving beacon, aerodrome boundary lights, marker lights giving the most favourable points of approach, lights illuminating the wind cone, obstruction lights and aerodrome flood lights.

22 Accumulators

Pouchain accumulators. (C. Palestrino, Electtrotecnica, 13, pp. 617-619,
    25.9.26. Abstr. in Sci. Abstr. B, Vol. 30, No. 349, 25.1.27.) (21.1/5284
    Italy.)
    Gives the results of tests of Pouchain accumulators at high rates of discharge. It is found that these cells will withstand without damage a discharge at four times the rate possible in the case of a lead accumulator, the comparison being made on the basis of watts per kg.

23 Calibration of Altimeters

*Tables for calibrating altimeters and computing altitudes based on the standard
    atmosphere.* (W. G. Brombacher, N.A.C.A. Report No. 246.) (6.333/
    5175 U.S.A.)
    The title is self-explanatory. The tables necessary for the use of the standard atmosphere in calibrating altimeters and in computing altitudes, form the principal part of this report. In Table I. are given the standard altitudes at pressure intervals of 0.1 millimeter of mercury in the range 87 to 200 millimeters of mercury and at intervals of 0.2 millimeter of mercury in the range 200 to 790 millimeters of mercury. In Table II. standard altitudes are given at intervals of 0.01 inch of mercury in the range 3.4 to 31.09 inches of mercury. In Table III. are given the pressure in inches and millimeters of mercury, the temperature, the mean temperature, and the corresponding isothermal altitude at every 500-foot interval of standard altitude in the range $-1,000$ to $+50,000$ feet. Temperature corrections for use in computing altitudes from observed pressures and temperatures are also given. An example of the computation of actual altitude from the necessary observations of pressure and temperature is included.

24 Suction Nozzles

Investigations of the flow in front of suction nozzles. (Dipl. Ing. Schulz, Z.V.D.I., Vol. 70, No. 41, 9.10.26.) (6.381/5347 Germany.)

These tests were carried out with suction nozzles of various forms (cylindrical and converging with rectangular prismatic mouth-piece and with sudden (sharp angled) or gradual (curved) transition between the cylindrical and expanded portions) having cross-sectional areas varying between 0.287 and 0.014 sq. m. As the direction of the flow was always unknown and considerable variations in the pressure and velocity values were to be expected in the field of measurement, the hot-wire method advocated by Zinn was used. Pressure and velocity were measured for various conditions of flow in vertical, horizontal and diagonal planes that always contained the axis of the nozzle which was horizontal in all the tests. The results of the measurements, agree comparatively well with the flow and velocity curves established from the theory of potential flow for two characteristic nozzles. At the periphery of the nozzle, owing to friction, the flow separates off the wall, dead water areas being formed. There is a nucleus of turbulent motion at the centre of the flow at the mouth, with comparatively steady flow between the nucleus and the disturbed region at the periphery. Owing to the vortices in the nucleus, an increase in the low pressure occurs, so that, at this point, it differs considerably from that calculated by Bernouilli's law of similarity for the flow in front of geometrically similar nozzles.

Other tests were carried out with one cylindrical and two converging nozzles to determine the most efficient form for the transformation of pressure into velocity with the smallest expenditure of energy. The converging nozzles were found to be by far the better as regards quantity delivered whilst for the production of high velocities in front of the nozzle (suction efficiency), the converging nozzle with the sharp angle transition is the only one giving advantageous results.

MATERIALS

25 Light Alloys

The corrosion of Magnesium and of the Magnesium Aluminium Alloys containing Manganese. (J. A. Boyer, N.A.C.A. Report No. 248.) (10.27/5580 U.S.A.)

The extensive use of Magnesium and its alloys in aircraft has been seriously handicapped by the uncertainties surrounding their resistance to corrosion. The report discusses the general nature of the corrosive action and metallographic study of corrosion.

It is concluded that (1) pure magnesium of ordinary ingot grade is quite resistant to corrosion by salt water, (2) the addition of aluminium increases the rate of corrosion, but the presence of a small amount of manganese counteracts to a large extent the effect of the added aluminium, (3) a critical amount or manganese is necessary to inhibit the corrosion of the aluminium alloys; at least 0.3 per cent. manganese should be present in the 4 per cent. aluminium alloy. Alloys which do not contain the critical amount of manganese corrode until completely disintegrated.

Several other conclusions are reached.

Lautal. (Fuss, Z. Metallk., 1927, 19, 19-21—abstr. in Brit. Chem. Abstr. B, 11.3.27.) (10.21/5581 U.S.A.)

Lautal (4 per cent. Cu, 2 per cent. Si, remainder commercial Al) is readily forged at 400-500° and subsequently hardened by ageing at 120-130°. The sandcast alloy has a tensile strength of 12-20 kg./mm.², an elongation of 4 per cent., and a Brinell hardness of 55-60; after ageing the corresponding values are

16-26 kg./mm.², 4 per cent. and 65-70.   The chill-cast alloy has a tensile strength of 15-25 kg./mm.², an elongation of 10 per cent., and a hardness of 66-80; after ageing these values become 20-30 kg./mm.², up to 10 per cent., and 90-110 respectively.   The alloy has been used satisfactorily for the framework of aeroplanes and motor boats and for the construction of the rotors of Flettner's rotor ship.

The Brinell Hardness of Lautal between 20-500 Deg. C.   (H. Kohrig, Zeit. f. Metallkunde, No. 10, Vol. 8, Oct., 1926.)   (10.21/5169 Germany.)

In this article the author reports on tests carried out on test-pieces of rolled sheet 6mm. thick and hardened to the normal value.   The test-pieces were heated up to 250 deg. C. in a tar oil bath and for the range between 250 deg. C. and 500 deg. C. in a melt of potassium and sodium nitrate.   Balls of 2.5 and 5mm. diameter were used.   The load was the same in all the tests, namely, 62.5kg. Two series of tests were carried out, one with the test piece at the temperature indicated for the test and the other after the test-pieces and cooled down from the given temperature in air.   The results are given in the following table :—

| | | Test-pieces Hot. | | | Same Test-pieces Cold. | |
| | | | | | | |
Temp. (deg. C.).	Diam. of 2.5 mm. ball.	Imprint 5 mm. ball.	Brinell No. (2.5 mm. ball).	Brinell No. (5 mm. ball).	Dia. of imprint (2.5 mm. ball).	Brinell No. (2.5 mm. ball).
20	0.815	—	116.5	—	—	—
50	0.82	—	115	—	0.815	116.5
75	0.82	—	115	—	0.813	117
100	0.843	—	109.5	—	0.815	116.5
125	0.87	—	102	—	0.817	116
150	0.92	—	90.8	—	0.82	115
200	1.08	1.12	64.8	62.2	0.845	108.5
250	—	1.335	—	44.0	0.883	98
275	—	1.5	—	34.8	0.91	92
300	1.63	1.72	26.3	26.0	0.96	83.4
350	—	2.16	—	16.2	1.03	71.6
400	—	2.86	—	8.8	1.095	63
450	—	3.23	—	5.7	1.087	64
500	—	3.67	—	5.0	1.06	67.4

Some new aluminium alloys.   (K. L. Meissner, Z.V.D. 1, Vol. 6, No. 52, 29.12.26—abstracted in Nachrichten fuer Luftfahrer, Vol. 8, No. 3, 20.1.27.)   (10.21/5568 Germany.)

Montegal.—The principal components of the alloy are magnesium silicide and calcium silicide in very small quantities.   Good weathering properties.

Constructal 2.—Strength properties similar to duralumin, due to relatively small quantities of inter-metallic combinations of Mg_2 Si Cu and Ti.   Easily worked up cold, high resistance to corrosion.

Constructal 8.—In addition to small quantities of components of high melting point, contains an inter-metallic combination of Mg Zn_2 which imparts particularly high strength values to the alloy.   By appropriate combinations of mechanical and heat treatment these values may reach 60 kg/sq. mm.

K.S. Seawater Alloy.—Casting alloy, contains Mg, Mn and Sb.   The resistance to seawater is mainly due to the protective action of the Sb, which, with the salts in the water forms an adhering layer of antimony oxychloride.

Strasser Casting Alloys.—Cast in various degrees of hardness according to the amount of the alloying components (from 3 to 8 per cent.)   These alloys have

the peculiar property of hardening by ordinary ageing without special heat treatment.

PROPERTIES OF THE ALLOYS.

Alloy.	Maker.	Tensile strength kg./sq. mm.	Elongation per cent.	Yield point kg./sq. mm.
Montegal.	⎧Berg A.G.	30 to 35	12 to 16	—
Constructal 2.	⎨Werdohl	Same as duralumin.		
Constructal 8.	⎩i.W.	48 to 53 (up to 60)	9 to 14 (5 to 7)	37 to 39
Aluminium Copper Alloy.	Aluminium Co. of America.	37.8	15	

Constructal. (W. Sander, Z. Metallk., 1927, 19, 21—abstr. in Brit. Chem. Abstr., B., 11.3.27.) (10.21/5562 Germany.)

Constructal is an aluminium alloy containing only 3 per cent. of alloying elements, chiefly zinc, and, after ageing, has a tensile strength of 40 kg/mm², an elongation of 22 per cent., and a Brinell hardness of 118. By modifying the ageing conditions a tensile strength of 52 kg/mm² with an elongation of 10-12 per cent., an elongation of 26-28 per cent. with a tensile strength of 36-38 kg/mm², may be obtained. Another form of the alloy containing a somewhat larger proportion of other elements has a tensile strength of 60 kg/mm², and a much better resistance to corrosion than ordinary aluminium, owing to the alloying elements being entirely in solid solution.

Scleron and Aeron. (E. Scheuer, Z. Metallk., 1927, 19, 16-19—abstr. in Brit. Chem. Abstr., B., 11.3.27.) (10.21/5561 Germany.)

Scleron is an aluminium alloy resembling duralumin, but containing lithium in place of all or part of the magnesium; it is characterised by a high resistance to change of shape, by a high tensile strength (40-50 kg/mm²) and hardness, and by a good elastic limit (20 kg/mm²) and limit of proportionality 30 kg/mm².

Aeron, on the other hand, is a copper-aluminium alloy which can be improved by ageing, and is characterised by great pliability, having an elongation of 18-25 per cent., with a reduction of area of 30-40 per cent., combined with a tensile strength of 36 kg/mm², an elastic limit of 12 kg/mm², and a limit of proportionality of 20-24 kg/mm². Scleron thus resembles a mild steel and aeron wrought iron in mechanical properties. The sp. gr. of the alloys are 2.95 and 2.8 respectively, the coefficients of expansion 2.6×10^{-5} and 2.36×10^{-5}. the thermal conductivities 0.24 and 0.36, and the electrical conductivities 16.7 and 24. The heat treatment of scleron comprises quenching from 480° and ageing at the ordinary temperature for a few days. The greatest hardness of aeron is obtained by ageing at 100-120° after quenching at 500°; both alloys are completely annealed again by heating at 300-350°. Aeron is a little more resistant to attack by sea water when aged below 100°, and much less when aged at higher temperatures than is commercial aluminium.

Solution of Aluminium and its alloys in acids. (Inspector General Grard Bull. Techn. du S.T.Ae., No. 37, pp. 1-51.) (10.21/5537 France.)

The rate of solution of aluminium in hydrochloric acid is studied in relation to the effects of grain, impurities, treatment, etc., in Chaps. I.-V. In Chap VI. the rate of solution in caustic soda is studied. An electro-chemical theory is developed and applies to both acid and alkali solvents.

Protective coatings for duralumin and similar light weight alloys for exposed construction. (H. A. Gardner, Am. Paint and Varnish Manufrs. Assoc. Circ. No. 296, 1-26 (1927)—abstr. in Chem. Abstr., Vol. 21, No. 4, 20.2.27.) (10.27/5340 U.S.A.)

Contrary to usual thought and practice, tests prove that basic pigments, such as red lead and ZnO, are highly suitable on AI and other light alloys. Results are given of the protective action in exposure tests of many varieties of coatings including lacquers. Long linseed oil or tung oil varnishes with AI or C pigments are well suited for AI alloy protection.

26   Steels

Investigations of Martensite. (Report No. 61 of the Verein deutscher Eisenhuttenleute reviewed—Z.V.D.I. No. 5, Vol. 71, 29.1.27.) (10.11/5528 Germany.)

The report under review deals with the investigations carried out by Hanemann and Schrader with a view to finding a new solution for the old problem of the processes of hardening in steel. From critical study of the results of research on martensite relative to structure, elongation, critical points in decalescence and recalescence and X-ray investigations the authors came to the conclusion that the prevailing views on the formation and structure of martensite were improbable. Their own conclusions are to the effect that martensite is not a iron but occurs at a temperature between 200 and 400 deg. C. when a temperature colour and a change in length become apparent. The reviewer explains how Hanemann and Schrader built up the $\xi\eta$ hypothesis which they have been able to prove by examination of the hardened structure of a number of steels.

Effect of Velocity on Corrosion of Steel under Water. (R. P. Russell, E. L. Chappell and A. White, Ind. and Eng. Chem., Vol. 19, No. 1.) (10.15/5550 U.S.A.)

The paper discusses the effect on the rate of corrosion of the velocity of liquid flowing past submerged metal surfaces. Data given in the article show that, when cleaned or polished steel is corroded under water for short periods, the corrosion may be high at low velocities and becomes less with further increase in velocity. When steel is rusted previously, however, the corrosion at velocities up to 4ft. a second is greater than the corrosion observed at very low velocities.

27   Glass

Some recent types of absorbent glass. (G. Jaeckel, Z.f. Tech. Physik, pp. 301-304, 1926—abstracted in Z.f. Instrumentenkunde, Vol. 47, No. 2, Feb., 1927.) (10.51/5566 Germany.)

In this article several types of glass transparent to ultra-violet rays are described, some of these being also transparent to the visible spectral range (crown glass transparent to ultra-violet rays) and some reducing more or less the intensity of the visible spectrum (blue glass, transparent to ultra-violet rays, reducing the long-wave portion of the spectrum up to about 440mμ and black glass transparent to ultra-violet rays and absorbing the entire visible spectrum). The Sendling or black glass is tinted with nickel oxide, and in thin sheets is transparent to extreme red and extreme violet rays. With a thickness of 4mm. it is practically opaque to visible light, but is as transparent as crown glass to ultra-violet rays. It is very useful for examining very weak fluorescences which have also been examined by this means on absorbent glasses. Whilst cerium glass shows a luminous blue fluorescence, and vanadium glass a greenish brown fluorescence, yellow (cadmium sulphide) glasses show light yellow, yellow-orange and deep red fluorescences, according to the position of the limit of absorption

for short-waves. These yellow glasses derive their fluorescence characteristics from being annealed at 640 to 720°, the colour deepening with the increase of temperature and duration of the anneal. Unannealed yellow glass shows no fluorescence, thus indicating that the fluorescence and absorbent properties of these glasses are only due to annealing and the consequent formation of colloids in the glass. By annealing in a furnace with uneven distribution of temperature, it is possible to anneal a yellow glass to a " wedge " of graduated shades. The movement of the limit of absorption and of the colour of the fluorescence towards the long-wave region is due to a growth of the colouring colloid. Accordingly a " yellow wedge " shows a notable variation not only of yellow colouring, but also of the colour of the fluorescence, along its length. The author deals further with the relationship between the absorption limit, colour of fluorescence and growth of the colloid.

Physical Properties of Glasses—Relationship to Chemical Composition and Mode of Preparation. (W. E. S. Turner, J. Chem. Soc., pp. 2091-2116, Aug., 1926—abstr. in Sc. Abstr. A., 25.2.27.) (10.51/5336 Great Britain.)

A review of the present state of knowledge with regard to glasses, with special reference to recent work. The effect of the component oxides or elements on the physical properties is discussed. Special reference is made, amongst properties of the constitutive type, to viscosity, annealing temperature, electric conductivity, and resistance to water and chemical reagents. Amongst properties of the additive type, special consideration is given to thermal expansion, density, refractive index and dispersion. The importance of these data in the commercial preparation of glasses designed for specialised uses (*e.g.,* optical glasses of specified refractive index and glasses which furnish resistance to the action of water and acids and which show a high degree of immunity towards sudden changes of temperature) is stressed.

28   Dopes and Paints

" Fireproof " paint. (F. S. Vivas, U.S. Patent No. 1,612,671, 28.12.26—abstr. in Chem. Abstr., Vol. 21, No. 4, 20.2.27.) (10.45/5339 U.S.A.)

A paint adapted for use on wood, paper or other materials is formed from a drying oil, Zn white, $PbSO_4$, $PbCO_3$, finely divided inert filling material such as SiO_2 or kaolin, borax, K alum, H_3BO_3, Na tungstate and a thinner. U.S. 1,612,672 specifies a paint formed of oil, ester gum, thinner, pigments, SiO_2 and Zn stearate. U.S. 1,612,673 specified a fire-resisting varnish formed with drying oil, varnish gum, glycerol, lime Co acetate or Pb acetate, a thinner, borax, H_3BO_3, Na tungstate and perchloroethane.

Nitrocellulose Lacquer Films. (G. W. Rundle and W. C. Norris, Proc. Amer. Soc. Testing Materials, 1926, 26, Part 2, 546-555—abstr. in B.C.I.R.A. Information Bureau.) (10.42/5560 U.S.A.)

Films for stress-strain measurements are easily prepared by flowing them on amalgamated tinned sheet-iron panels, setting them up at an angle of 15° to the vertical and allowing the excess material to flow off. The influence of thickness of film, humidity, temperature and variations in lacquer composition on the results of stress-strain measurements are discussed.

29   Comparative Hardness of Metals

Comparative Hardness of Certain Metallic Elements. (Letter from A. Mallock in Nature, 19.2.27.) (10.62/5282 Great Britain.)

Referring to a description of a method of determining hardness given in Nature of January 23rd, 1926, a table is given of 24 metallic elements arranged in order of hardness.

Hardness stated in tons/square inch.

Metal.	Hardness.	Remarks.
1. Iridium.	240	M.
2. Molybdenum.	158	M. Wire.
3. Tungsten.	144	Thin plate, slaty fracture.
4. Rhodium.	128	M. Wire.
5. Nickel.	112	M. Wire.
6. Chronium.	109	Cast. Crystalline aggregate.
7. Cobalt.	99	M. Cast.
8. Titanium.	77	Plate, slaty fracture. Brittle.
9. Manganese.	60	Cast. Crystalline aggregate.
10. Iron.	56	M. From ingot made by Merriot process. Pure.
11. Copper.	50	M. Wire.
12. Aluminium.	29	M. Wire.
13. Vanadium.	28	Crystalline aggregate. Brittle.
14. Palladium.	28	M. Wire.
15. Silver.	25	M. Cast.
16. Magnesium.	22	M. Cast.
17. Zinc.	21	M. Cast.
18. Gold.	20	M. Cast.
19. Calcium.	17.5	Crystalline aggregate. Brittle.
20. Cadmium.	12	M. Cast.
21. Bismuth.	8	Large, crystal.
22. Tin.	7	M. Cast.
23. Lead.	3	M. Cast.
24. Thallium.		

30   Welding and Soldering

Fusion Joining in Aircraft Construction.   (American Machinist, 15.2.27, p. 954.)
(10.22/5290 U.S.A.)

The adaptability of arc and gas welding is referred to. Alloy steels are discussed, and it is stated that chrome-vanadium steel may be brazed to chrome-molybdenum tube without difficulty. Nickel-steel bar and tube is stated to be difficult owing to cracking. Aluminium welding is also referred to, but it is only employed to a minor extent.

31   Internal Structure of Metals

Direct stereoscopic optical investigation of the internal structure of bodies, especially crystals.   (Dr. H. Herbst, of Jena, Zeit. f. Instrumentenkunde, Sept., 1926.)   (10.63/5162 Germany.)

This article describes a method of rendering the molecular structure of crystals and similar bodies directly visible by means of the " Atom-miscroscope," in which the action of Rontgen rays or other rays of even shorter wave-length is combined with that of ordinary or ultra-violet light rays in such a way that the visible or ultra-violet rays simultaneously or successively follow the same or the inverse path as the Rontgen rays deflected or bent by the object, the visible or ultra-violet rays being then collected in the usual way by means of glass or quartz lenses or by a system of prisms as in the binocular microscope, so as to give a binocular stereoscopic image, allowing the internal structure of the body to be viewed directly in three dimensions. The path of the deflected Rontgen rays can be marked in the usual way by a photographic plate or screen, and the stereoscopic image can also be measured stereoscopically.

The essential difference between this " Atom-microscope " and the ordinary or ultra-microscope is that the latter only permits of viewing the external shape of

the object, whilst the former actually renders visible the internal structure and the arrangement in space of its components, the object being illuminated from two different sides by a bundle of rays of short wave-length, and the resulting " shadows " or " reflected " or " deflected " rays caught on two screens or photographic plates which are viewed through a stereoscope.

32   Selenium in Rubber Compounds

(C. R. Boggs and E. M. Follansbee, Trans. Inst. Rubber Ind., 1926, 2, 272-304— abstr. in British Chem. Abstr. B, 4.3.27.) (10.52/5338 England.)

A review of the uses of selenium in rubber compounding. Selenium can be used as a vulcanising agent or to accelerate vulcanisation by sulphur, the latter effect being attributed to the formation of selenium sulphide. The enhanced rigidity and abrasion resistance of tyre tread " compounds " vulcanised with a sulphur and selenium in the presence of an organic accelerator are probably due to the joint addition of the two elements to the rubber molecule.

ARMAMENT

33   Toluene

(S. J. Dickey, Army Ordnance, Vol. 7, No. 40.) (9.8/5277 U.S.A.)

The article constitutes a general survey of toluene production, including a consideration of sources, recovery from coke oven and city gas, improvements in absorption recovery systems, special cracking processes, selection of oil for cracking and separation of paraffin and aromatic hydrocarbon oils.

34   Flexure of Thick Circular Plates

(C. A. Clemmow, Procs. Roy. Soc., 112, pp. 559-598, 1.10.26—abstr. in Sc. Abstr. A., 25.2.27.) (9.6/5329 Great Britain.)

This investigation arose out of a suggestion that the deflection of a circular steel plate, firmly held at the edge, might be used as a measure of high explosive pressures. The plate would form the base of a cylindrical closed vessel of the usual type, and the measurement made would be that of the normal central deflection of its external flat surface. Three types of solution of the problem have been considered ; (1) that in finite terms; (2) that in infinite series involving hyperbolic functions of z and Bessel functions of r; (3) that afforded by a combination of (1) and (2) ; r and z are cylindrical co-ordinates and 2h. is the thickness. No one of the above has been found to solve the problem in its complete generality; (1) leads to the usual results for thin plates of neglected thickness; (2) is of restricted application, as boundary conditions at the edge referring to one displacement only can be satisfied ; (3) in various forms permits of the discussion of a variety of problems, the method being to satisfy the stress boundary conditions over $z = \pm h$, and then to consider different boundary conditions at $r = a$. Methods have also been indicated for the discussion of the problem for the case of non-uniform loading, particularly when the load is concentrated entirely at the centre. The theoretical results for thick plates are expressed in the form of infinite series, which have been reduced to simple terms so that concise approximate expression for stresses and displacements are obtained which are valid in most cases, even for comparatively thick plates. The paper is mathematical throughout, and the distribution of stress throughout the plate in the cases considered is given by tables.

35   Husan-Andrews Enemy Speed Finder

(Engineering, 18.2.27.) (9.56/5287 Great Britain.)

An instrument made by Messrs. Henry Hughes for determining the speed and course of an enemy ship attacked by torpedo-carrying aircraft is described and illustrated.

AIRSHIPS

36   Helium

U.S.A. helium supply.   (A. and N. Register, 18.12.26.)   (12.62/5185 U.S.A.)

It is stated that the shortage of helium is seriously handicapping both Army and Navy airship operation in the U.S.A. and is preventing the development and storage of reserve of helium. The Army is stated to have about three million c. ft., and the Navy about $2\frac{1}{2}$ million c. ft., and in each case it is nearly all in use; the cost of production is given as being fifty dollars per thousand c. ft.

Helium.   (U.S. Air Services, March, 1927.)   (12.62/5334 U.S.A.)

Rather more than a million dollars (£200,000) has been voted for helium for the next fiscal year. The whole amount is intended for an extension of the sources of supply for the helium-bearing natural gas. It is stated that an adequate supply of helium will thereby be assured for Army and Navy airships for a number of years. The amount given above does not include further amounts for the purchase of helium during 1928.

37   Pressure Distribution on Hulls

Estimation on Pressure Distribution on Airship Hulls.   (Th. v. Karman, Researches at the Aachen Technical High School.)   (12.31/5531 Germany.)

Model calculations are given for the Z.R.III. hull form with the following simplifications :—All external organs are supposed to be removed, and each section is replaced by a circular section of equal area. The calculations are then carried out for axial motion and for oblique motion. In both cases a velocity potential is assumed. In the first case the resultant drag due to normal pressure forces is zero. In the second case a resultant couple is produced which tends to turn the airship broadside to the relative wind, but there is still no resultant force. To estimate the latter case in which the pressure distribution especially at the bows is seriously modified, it is assumed that a vortex formation follows the hull, much as in the case of an aeroplane wing. Suitable assumptions as to the distribution of vorticity actually lead to good agreement with the experimental determination. The author states that he has made calculations with reference to other forms investigated experimentally (by Fuhrmann and on English models) and has found very satisfactory agreement. A warning is added that in general critical points may exist requiring special treatment. He considers that a continuous distribution instead of a step by step distribution of sources will satisfy every case, and justify the method to mathematicians.

38   Substitutes for Gold-beaters' Skin

(Aviation, 14.2.27, p. 323.)   (12.63/5281 U.S.A.)

In the course of an article on the present airship situation in the United States, Commander Rosendahl states the experimental work has been carried out on a substance known as Cellophane, which would replace the gold-beaters' skin now used in the construction of the gasbags of airships.

MISCELLANEOUS

39   Meteorology

Equations of atmospheric disturbances from a steady state.   (v. Bjerknes, Oslo, Z.f.A.M.u.M., Feb., 1927, pp. 17-26.)   (6.23/5311 Germany.)

The author premises the intractable nature of the general equations of viscous fluid motion and proposes as a first step the investigation of small disturbances of an initially steady state.

The general equations are written down and reduced to known solutions in the very simplest cases. For more general solutions various simplifications are

suggested. Various general conclusions are drawn from the form of the differential equations. An appreciative reference is made to Appell's Traite de Mecanique Rationelle, Vol. III. Appeal is made to mathematicians to develop methods of solution, and to meteorologists to look at the problem as a hydrodynamical one and to advance by empirical methods.

Application of the equations of hydrodynamics to meteorology. (H. Hergesell, Works of the Prussian Aeronautical Observatory, Lindenberg, Vol. 15, 1926, pp. 155-162.) (6.23/5538 Germany.)

The author discusses the significance of the usual meteorological data as space-means and time-means, and examines the validity of inserting daily and yearly means in the equations of hydrodynamics which hold strictly only for instantaneous values. In reducing n systems for n points of observation by use of the arithmetic mean, additional terms arise from the correlation between the meteorological data, but are negligibly small as appears from use of thirty years' records at Stykkisholm.

40 The Use of Models in the Solution of Indeterminate Structures

(G. E. Beggs, Franklin Inst., Vol. 203, No. 3, March, 1927.) (12.2/5570 U.S.A.)

In order to avoid laborious mathematical solutions a practical method of solving many types of indeterminate structures by the aid of elastic models has been developed. It is based upon the fundamental principles underlying many mathematical methods, in particular Maxwell's theorem of reciprocal deflections. Each indeterminate quantity is directly expressed as a function of a known load and two measurable deflections. Furthermore, since the solution by use of models allows all stress components to be determined from measured deflections, there remains for checking purposes the three unused equations of statical equilibrium. The article discusses the underlying principle of the solution of structures by the use of models and illustrates the apparatus used.

41 The Measurement of Transmission and Reflection of Sound by Partitions of Various Materials—I. Felt-Like Materials

(A. H. Davis and T. S. Littler, Phil. Mag. S. 7, Vol. 3, No. 13, Jan., 1927.) (5.61/5186 Great Britain.)

The paper is part of a study of the transmission and reflection of sound by various partitions, and relates mainly to partitions of a felt-like nature. The method used is on the general lines of that due to F. R. Watson. The partition is clamped over an aperture in the wall between two adjacent sound-proof rooms, in one of which a source of sound, in conjunction with a paraboloidal mirror, directs a fairly uniform beam of sound obliquely on to the partition. Measurements of intensity are made in the transmitted and reflected beams and at various other points within the rooms. A description is given of the electrical equipment used in the production and measurement of the sound-field. A detailed study of the field of sound in the two rooms was made both with and without a partition over the aperture. The results of this exploration showed that transmission and reflection ratios were almost independent of the positions in the beam at which the measurements were made. A number of partitions were tested, and the consistency of the results is indicated in graphical form. The transmission of sound through felt was specially investigated. Four partitions of hair-felt, each of 0.58in. thickness, were employed, and the transmission through one, two, three and four layers was studied. A number of frequencies ranging from 250 to 1,600 vibrations per second were used, and curves are given showing the results obtained. A comparison is made between these results and those obtained by P. E. Sabine, who used a reverberation method.

42 Retention of a Ball by a Vertical Water Jet

(W. C. Baker, Science, 64, pp. 161-163, 13.8.1926. Abstracted in Sci. Abstr. A., Vol. 30, No. 349.) (6.32/5180 U.S.A.)

A ball, mounted on a horizontal axis, the horizontal pull on which is measured by a delicate spring device, and provided with vertical slide on which the water can impinge on leaving the ball, shows the following facts. When the ball is at such a height that its weight is balanced by the vertical thrust of the jet and the slides are drawn to allow free passage for the water leaving the ball, the ball is acted on by a horizontal force varying with the point of impact, increasing to a maximum of about half the weight of the ball if the latter is allowed to rotate freely about its horizontal axis. The force is lessened by about 40 per cent. if the ball is fixed. If the slides are closed, the impact of water on them entirely neutralises this horizontal pull. It is concluded that the force is entirely due to the creation of a horizontal momentum component, and that the law of Bernoulli plays a very small part in causing it.

43 Selenium Cells

(J. of Sci. Instruments, Vol. 4, No. 2.) (6.79/5179 Austria.)

An account is given of a demonstration of selenium cells made by Professor Thirring, of Vienna, before the Physical Society. He considered that the best method of getting over the inertia of the selenium is to cut the light up into flashes by a revolving sector disc, amplify the fluctuations and rectify them by a shutter on the spindle of the disc. By this means and by focussing the light of a distant small lamp on a cell in a camera, he stated that it had been found possible to effect reliable communication over a channel three miles wide in broad daylight.